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Compressed Air Magazine

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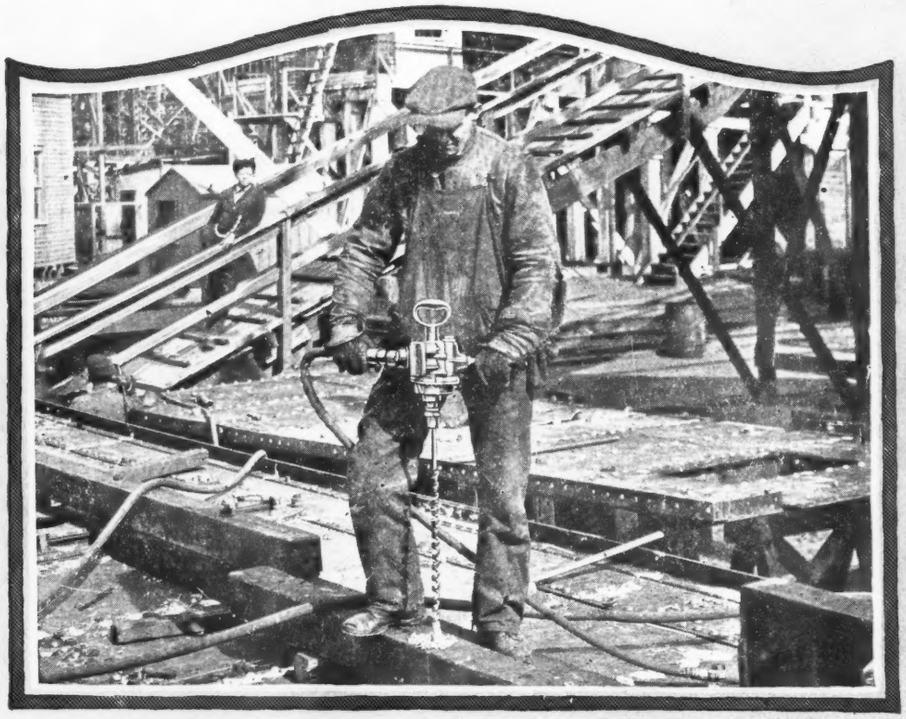
JUNE, 1920



PNEUMATIC TOOLS BUILDING RIVETED SHIPS AT HOG ISLAND SHIPYARD

Riveted Ship and Her Skipper Win Sea Triumph
Francis Judson Tietsort

Pneumatic Tubes in Central Telegraph Office, London
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E. P. McCrorken

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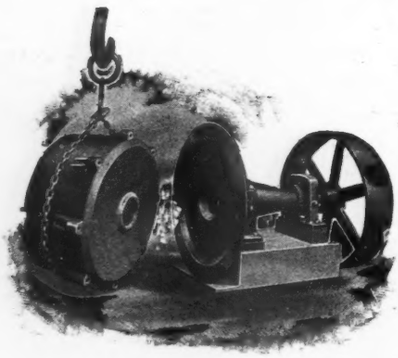

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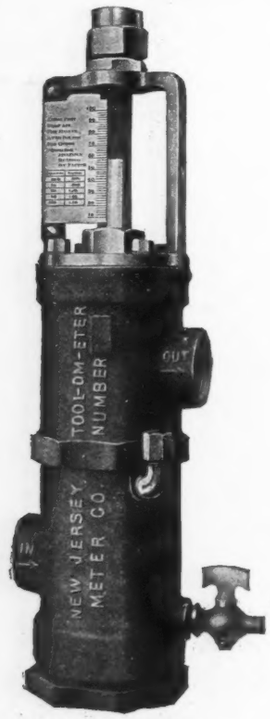
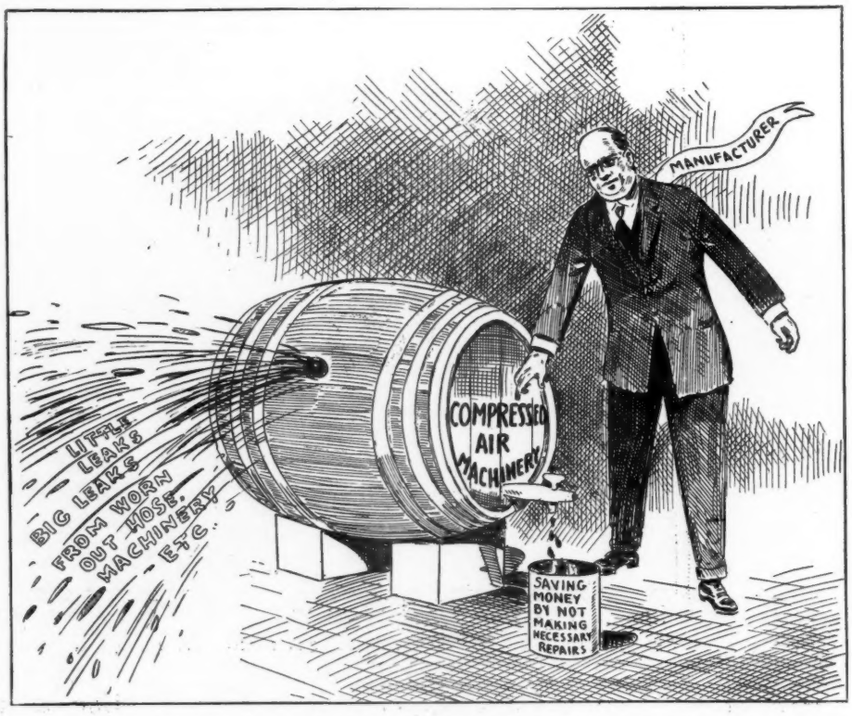


TOOL-OM-ETER

"The Meter That Meets The Trouble From Leaks"



SAVING PENNIES ON REPAIRS—WASTING DOLLARS IN AIR LEAKAGE

The above cartoon reprinted from Compressed Air Magazine, April, 1920, page 9633, shows the plight of any air user who fails to investigate his losses.

Write for Bulletin 5-A

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Compressed Air Magazine

A digest of compressed air and pneumatic practice, and also of engineering and industrial data germane to allied mechanical arts

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VOL. XXV, NO. VI *Contents Copyrighted* JUNE, 1920

Riveted Ship and Her Skipper Win Sea Triumph

Gallant "Liberty Glo" Hog Island Product, Blown in Two by Floating Mine, Buffeted by Gales, Proves Worth of Modern Air Riveting of Plates

By FRANCIS JUDSON TIETSORT

ON THE MORNING of April 7 of this year the telegraph department in the administration building of the world's greatest shipbuilding plant, that at Hog Island, Pa., was called by the cable bureau of the Western Union. The following cable message from Rotterdam came clicking over the wires:

LIBERTY GLO ARRIVED ROTTERAM.
STOUSLAND.

As word spread by "wireless" from man to man throughout the offices and out through the yard a cheer went up. Everybody congratulated everybody else and there was much pump-handle handshaking. That brief cablegram represented the final chapter in one of the most thrilling tales of the sea ever told. It recorded how the gallant *Liberty Glo,* her very name an inspiration, and as staunch a ship as was ever turned out by any shipyard, after being blown completely in two by a derelict German mine, and after being beached by her heroic captain, who stuck on his bridge, and after being pounded by terrific winter gales for four months on a most hazardous shore of Europe, that of the Dutch island of Ameland, had finally been salvaged, her cargo removed, and how she had been towed safely to the haven of a shipyard where she is now being made as good as new!

The terse cable dispatch from Captain Stousland, the plucky skipper, whose name has gone round the world as that of a modest hero of the sea, also recorded a great victory for a much maligned, a gratuitously traduced shipyard, and a vindication of the class of construction it has put into 102 ships thus far launched. It told the world that the intensive riveting methods used on the plates, employing the world's most modern and efficient compressed air apparatus, had demonstrated beyond question or cavil, their worth. The soundest construction, the best materials, the ablest workmanship by designers, engineers and shipwrights who took keen professional pride in their handiwork, had stood the severest test.

The manager of Dirkzwager's Salvage Company of Maassluis, Holland, which took the contract for salving the ship and her cargo, frankly stated that when his house had taken the job, it was general opinion that "the ship would not last long enough to get the cargo out." But he went on to say "that I never, in all my experience have seen a ship built as strongly and constructed in such a marvelous way (especially the famous bulkheads, of a strength I never saw before) as the S. S. *Liberty Glo,* and I take the opportunity to compliment the builders of the strongest and most remarkable ship ever stranded on the coast of the Netherlands."

THE S. S. "Liberty Glo," the thirty-sixth ship turned out at Hog Island, struck a floating mine while enroute from New York to Hamburg, Germany, on December 5, 1919. The force of the explosion that followed cut the vessel completely in two, from water-line to water-line, at No. 2 cargo hatch, the bulwarks and deck plates alone holding the vessel together. The accident occurred at a point 10 miles off the Netherlands coast. Eight hours later the vessel broke in two, both parts floating ashore 1¼ miles apart. Despite the severe storms that raged throughout the winter the salvaging gangs managed to save the greater part of the vessel's cargo and on April 4, 1920, the vessel was pulled into deep water by tugs and brought into Rotterdam on April 7, an unparalleled feat in the history of American ship construction.

Mr. A. S. Dirkzwager, the manager, in a statement made public this spring, also declared:

"Having been in the salvage business for years, I naturally have observed that ships when on the beach of Holland exposed to the North Sea, as a general rule depend for the success of their salving upon fine weather after stranding; failing in this, ships generally break up and soon fill with water, especially at the spot where the remarkable *Liberty Glo* ran ashore in a terrible Northwest gale, which is known to all seaman as one of the most dangerous of Europe.

"The *Liberty Glo* was an exception to this rule, remaining practically intact (the after part about 325 feet long) after four months on the beach of the Dutch island of Ameland in a place exposed to every gale, of which there have been plenty this winter. In fact it has been one of the most stormy winters for years, and with every storm, she has been subjected to such pounding as no other ship could stand and still she remains in a very good condition, only a few rivets leaking in No. 5 hold.

"During one of these gales, another new ship of about the same size as the *Liberty Glo,* stranded on the Isle of Terschelling, about fifteen miles from the spot where the *"Liberty Glo* stranded, and in less than four hours broke in two with every compartment full of water and no chance whatever of salving her—a notable difference from the *Liberty Glo."*

The foregoing testimony comprises interesting evidence respecting the quality of the ship that suffered and survived the ordeal, for seldom has any vessel been put to so severe a trial, but it can afford only a hint of what was passing in the experience of Capt. J. I. Stousland, who, practically single-handed, saved the craft. Mr. Mathew C. Brush, President of the American International Shipbuilding Corporation, has placed the entire case before Admiral W. S. Benson, Chairman of the Shipping Board, and highly commended the master of the *Liberty Glo* for his courage, perseverance, loyalty and ability as shown in the salvaging of his ship.

Captain Stousland's home ashore is at No. 275, Orient Way, Rutherford, N. J. When he was assigned to the command of the *Liberty Glo,* which was the 36th ship to be completed at Hog Island,he was a lieutenant-commander in the United States Naval Reserve Force. The vessel is a freighter, 7,800 tons, of 390 feet overall. When completed, she was placed on a transatlantic run between New York and Bordeaux, Pallice, Marseilles and Havre. Captain Stousland had seen long service in the merchant marine. He was born in Norway, but came to America when a lad, later going to sea in American ships. When assigned to the fast and seaworthy *Liberty Glo* he considered the ship, which he loved as a living thing, as one of his finest commands.

It was on November 20 of last year that he sailed from New York, bound for Hamburg with a cargo of oil and cotton, and having a crew of 30 men. On December 5, when only ten hours from her destination, the ship was cautiously making her way down the Netherlands coast in dirty weather. There was a short, choppy sea, and the sky was overcast, so that observations of the sun had been impossible for hours past. To make matters worse it was apparent that a gale was brewing and the captain was not comforted by the reflection that there were still many unswept mine fields in the neighborhood. A week before a ship had been blown up and sunk near this very spot.

Suddenly, without any warning, at half past two in the afternoon, the ship encountered a mine sidewise, not on her bow. The mine came in contact with the big freighter well aft, below No. 2 hatch. There was a crash of rending steel and a terrific concussion which shook the vessel from stem to stern, and then came a great roar, as the floating or partly submerged mine exploded. There was an upheaval of the forward well deck which spouted a volcano of oil, baled cotton and wreckage high in the air above the masthead. With the sea rushing in through the twisted and torn plates, the ship instantly began to sink, settling by the head. Her stern rose in the air, but as Captain Stousland ordered the watertight compartments closed, the ship was kept afloat. An S O S wireless alarm was sent out to the coast-guard stations, who replied with the laconic assurance, "Coming." But rescue from that source never came.

The wind having risen to a shrieking gale, racing seas buffeted the ship, carrying torn parts of the vessel before it. To add to the terror of the panic-striken men of the crew, their vision was shut off in all directions by a downpour of rain. The men wished immediately to abandon the ship, but Captain Stousland made up his mind to reach the land and beach the vessel.

George H. W. Weston, the chief engineer, who later died of exposure in the boats, with three other men, was meantime toiling below decks with his driving turbine and encouraging the "black gang" to keep up steam, while the

Commander Stousland in his uniform of a lieutenant in the Naval Reserve

wallowing ship plunged slowly toward the coast. All that kept the waters of the North Sea out of the engine-room were the thin plates of No. 3 bulkhead, yet the men stood by their positions as long as they thought it was serving any good purpose.

At this time all that held the two parts of the vessel together were a few deck plates. At eight o'clock in the evening, five and three-quarter hours after the explosion, the *Liberty Glo* came to anchor in seven fathoms of water just outside the white line of breakers off Ameland Island. It was still raining and the wind had increased. From this point the story may best be told in the words of Captain Stousland's report to the Shipping Board, which we have obtained from Washington:

"At ten P. M. she commenced to break up—bulwarks gradually opened up—I knew she was doomed. I sent out a call for assistance; but no result.

"Did you ever as a boy, see-saw? Well, that was just what the motion reminded me of.

"I never knew what held her together so long. You could see the bow go down—and the stern the same way. She was wriggling like a snake, but still she held.

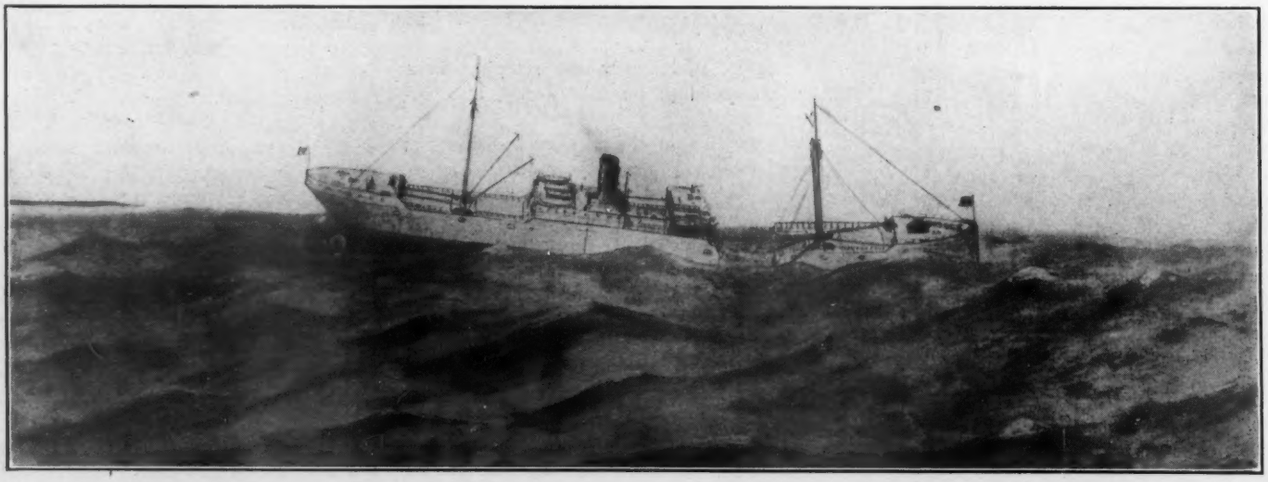
"The crew without exception were panic-stricken and it was only by using strong language that I got them away from the boats. After anchoring they would run to the boat every time they heard her cracking.

"It was a hellish night, the roar of the breakers, the grinding of the deck plates, beams and girders and the noise of escaping steam as the pipes broke. At four P. M. the men had lowered the boats, in all kinds of confusion, bent upon the one thing, getting away from the ship, and I will admit she was not a very desirable place to be in.

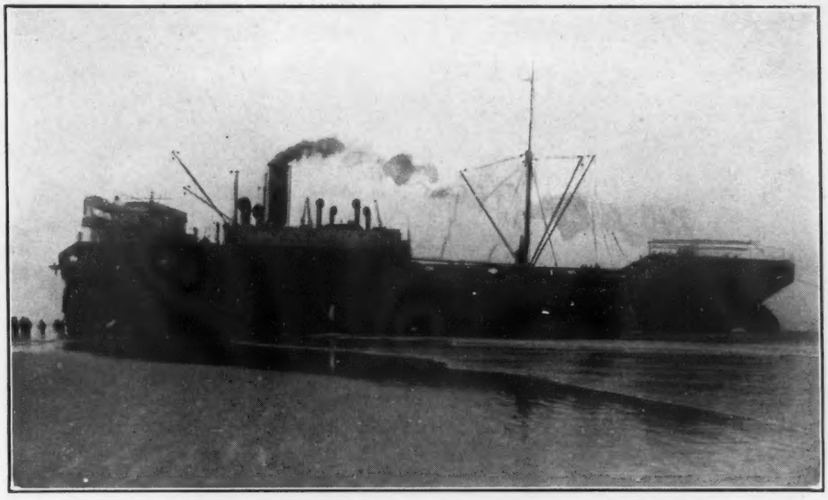
"I told them to remain under the stern and if the ship was remaining all night to come back, but they cut the painter and disappeared in the darkness.

"It flashed in my mind, as the men left in the boats, that if she did clear the breakers and drifted out to sea and was boarded by fishermen, I would want to be there, and as I had only a few seconds to make up my mind I decided to stay so that the boat could not be claimed as salvage.

"I was alone, standing on the forward part of the lower bridge watching her death struggle, and it was a wonderfully impressive sight. The iron girders, beams and deck plates, were struggling for supremacy against the elements—she twisted and bent one way and then the other, and finally at 4.30 A. M. she broke in



The S. S. "Liberty Glo," which struck a submerged mine in the North Sea on Dec. 5, 1919, ten miles from Ameland, Holland



After part of S. S. "Liberty Glo" ashore at Ameland Island

two. With a tremendous roar of protest the after part split from the bow and gradually drifted down toward a gleaming white outline in the darkness, looking like the white teeth of a wolf waiting to devour her—the breakers.

"I was half dazed and could not quite connect things in my mind. It happened so fast. The night was dark—no lights—the noise of escaping steam, and what would that part of her that I was on do?

"At just about 6.30 A. M. she struck in the breakers, sea washing clear over—every time she hit one would expect her to split in two. Finally she settled broadside in the surf."

After this desperate night, daylight finally came and Captain Stousland, standing alone on the bridge of his ship, could make out faintly, through the lightening gloom, the beach beyond the raging line of surf. He could just distinguish the towers of Ameland Island lighthouse ahead. At ten o'clock in the morning the coast-guard on the beach launched a lifeboat and after a struggle with the breakers managed to get alongside of the ship, and Captain Stousland made a leap for life into a net held for him.

Thereafter the gale drove the hulk of the *Liberty Glo* higher on the sand and when the wind abated somewhat she lay at the tide line.

Of the forepart of the ship only the tip of a mast still showed above the water. In the course of that day Captain Stousland ascertained that of the four boats that had got away in the night, two had made their way through the surf at Ameland; one, with Chief Engineer Weston and three of the crew dead from exposure, had made the Isle of Juist; another boat was missing. This last boat, it was subsequently learned, had been picked up by a German tramp steamer which had later landed the men at Bremen.

Had the men of the crew stuck with their captain on board the ship throughout the night they would all have been saved and much suffering would have been prevented. It is hard to control men, however, when they are driven by terror under such circumstances. But even as Captain Stousland afterward testified, "the ship was not a very desirable place to be in."

So far as we have been able to learn, there has never been a similar instance of a ship blown completely in two being of such sturdy and high grade construction that both ends floated, the after end being saved practically intact, together with the cargo. This ship of course carried the highest rating of British Lloyds and of the American Bureau. The story of what Captain Stousland and the men of the salvaging crew went through in the course of the four months of winter gales which were withstood by the *Liberty Glo*, would make a story in itself. Storm after storm tore at the helpless hulk buried in the beach sand. A letter written by Captain Stousland to Mr. Brush dated "On board *Liberty Glo*, April 1st, 1920," will indicate the final struggle to get the major part of the craft into deep water. We quote the letter as an indication of what the final feat of towing the ship into Rotterdam meant, at least in the mind of her devoted Captain:

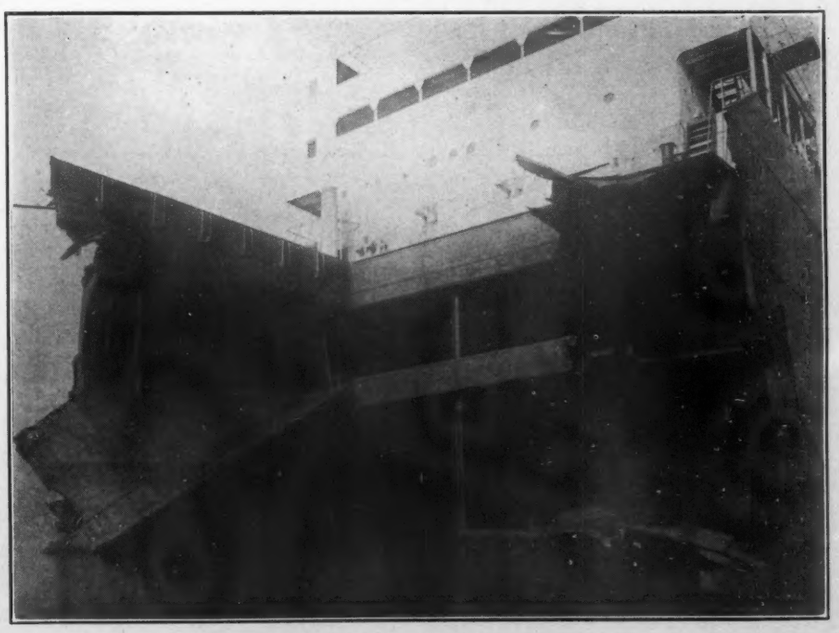
"After 12 days of hard work, every high tide night and day—watching and waiting—ship has come over 1200 feet. She is now resting on the last sand bar—the stern in deep water but upon the bank from No. 4 hold forward.

"We have met with all kinds of handicaps—very little water—sea too choppy for the sand sucker to work—and this morning we have the anchors home and they must be shifted. *All* cargo discharged and the value over half million dollars. Ship not leaking when still but opens up when moving—every precaution taken—in No. 5 lower hold a 5 in. duplex pump, the bilge pump on No. 4, spar pump on the tunnel, ballast pump on the tanks, the turbine pump connected up with the engine room and the oil piped to the fireroom.

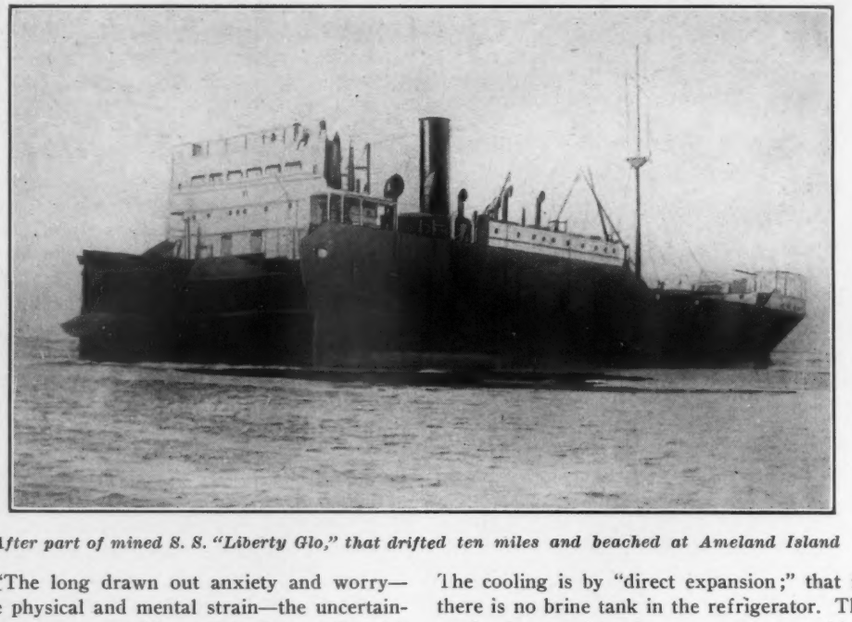
"It has been a fight—pulling and dragging every foot gained and now when victory is almost in our grasp it looks very much as if our attempt of getting the last 100 feet should be frustrated by bad weather—the outlook not promising—barometer low and every indication of a N. W. blow—and she is in a bad place—on the outside bank where the breakers are ugly and she will not remain there. Another 24 hours good weather and the trick is done,—bad weather and I can hear it ring in my ears: 'I told you so.'

"*If* she goes in again, she will come out again, in much less than 12 days. *She will come off*—but I may have to do it all over again. She is very dry, about 16 feet in the broken end, 15 feet aft. All the support carried away forward and I do not know what is holding the superstructure from caving in—what will she do when out in the North on her way to Rotterdam, a distance of about 120 miles?

"I think it is a most remarkable case and I do hope that in the event of her getting to Rotterdam—it would hurt very much if she is sold. I hope they will decide upon rebuilding her—a new fore ship from No. 3 bulkhead and bottom repaired.



Showing close-up view of S. S. "Liberty Glo" at point where sections of the ship broke apart



After part of mined S. S. "Liberty Glo," that drifted ten miles and beached at Ameland Island

"The long drawn out anxiety and worry—the physical and mental strain—the uncertainty of most everything—all begin to tell and I most earnestly hope it will soon end but it must end successfully.

"Received a very encouraging letter from the Division of Operations, in Washington. They seem to be much interested, as I know you are and if hard work and constant attention will count, you shall have your fleet intact.

Thanking you for all your kindness, I remain,

Very cordially yours,
(Signed) J. STOUSLAND."

Finally came the cable from Captain Stousland to Hog Island announcing the safe arrival of his ship at the Rotterdam drydock. It is a brave tale of a staunch ship, of the heroism of her daring skipper and of added lustre in the merchant marine of the United States. Every shipbuilder and every seafaring man has felt a glow of pride in the record of both captain and ship enduring so trying an ordeal.

From its material aspect, if the tale teaches anything, it is that the American riveted ship, as fabricated at Hog Island, is afloat to stay!

AIR COOLED CONDENSER FOR NEW FRIGIDOR UNIT

IT WAS recently announced that the newly formed Balsa Refrigerator Corporation had acquired the patent rights of the frigidor, a self-contained refrigerating unit especially designed for home use. The company is successor to the Frigidor Corporation, which carried on the experimental and development work.

These frigidor units are at present offered in two sizes, having the same refrigerating mechanism built into standard refrigeration boxes of eleven and fifteen feet inside cubic space. Under the proposed development by the new company these machines will be installed in boxes constructed with balsa wood insulation, as soon as manufacturing facilities permit.

The refrigerating unit is of the evaporation type and uses methyl chloride as a refrigerant. The cooling is by "direct expansion;" that is, there is no brine tank in the refrigerator. The mechanism consists of a pressure pump, which, driven by a one-quarter horse power electric motor, condenses the methyl chloride. This, by expanding in coils in what is ordinarily the ice chamber of the refrigerator, takes up the heat in the box—that is, keeps the box cool. The methyl chloride then returns through the condensing coils and so back in to the pump, the flow being controlled by an automatic valve.

A current of air is used for cooling the condenser, which does away with cumbersome and costly water connections. Only "plugging in" to an electric light socket is necessary for the installation of the unit.

One of the chief features of the frigidor is the ease of removal of the refrigerating unit from the enclosed compartment underneath the food chambers, so that repairs can be quickly carried out with no inconvenience to the user.

The temperature inside the frigidor is kept constant by an automatic control which starts and stops the operation of the mechanism as need be. It is actuated by a thermostat which can be set by the user to maintain any temperature within the limits of twenty degrees and 45 degrees Fahrenheit. When set at temperatures below 32 degrees Fahrenheit, the frigidor will freeze ice in suitable pans provided for the purpose and will keep such things as ice cream and ices hard for any length of time.

The average daily current consumption is two to two and one-half kilowatt hours, costing under normal current rates from one-quarter to one-half as much as the ice supply would for a box of equal size. A further great saving is due to the elimination of food waste, as edibles can be kept in the Frigidor for weeks without losing their freshness.

For the purposes of a blast which was fired recently at the Bonawe Granite Quarries, Loch Etive, 16 tons of gunpowder were used, and it is estimated that 300,000 tons of rock were brought down.

CABINET FOR SANDBLASTING RODS PROTECTS OPERATOR

A new cabinet for the sand-blasting of various shaped rods, from ⅜ in. to ⅞ in. diameter, just produced by the Pangborn Corporation, Hagerstown, Maryland, embodies some novel features of continuous operation, with hygienic construction for protection of the operator.

The blasting operation being entirely confined, the cabinet can be readily installed with other machine tools without detriment; this feature also removes the operator from all contact with the dust laden air.

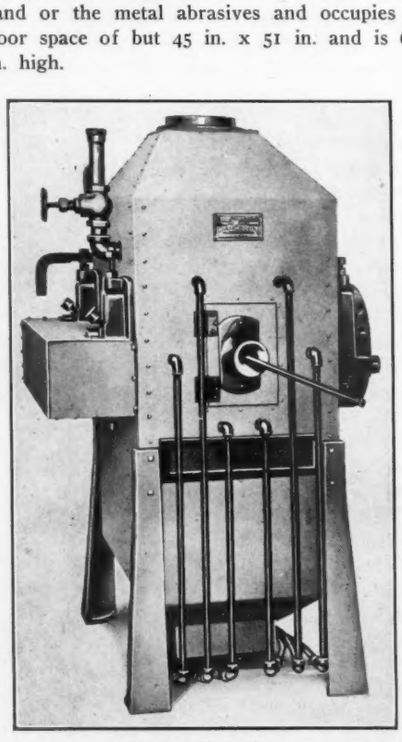
A set of rolls and guides at either end of the cabinet provides constant, uniform travel of the rods through the blasting zone. The feed rolls are shaped to handle all diameters from ⅜ in. to ⅞ in. and of varying shapes.

By six blast projectors, centering to the rod at a 45 degree angle, the blast stream covers the entire surface of the rod, the discharge being directed toward or into a small chamber that utilizes the rebound effectiveness of the abrasive.

Scale has been removed from ¾-in. diameter rod, with 80-lb. air pressure at 50 lineal feet per minute.

The bottom of the cabinet forms a hopper for abrasive storage. The blast action is of the suction type and individual feed boxes in plain sight of the operator feed each blast projector. Connection to an exhaust system removes disintegrated material.

The cabinet is adaptable for use with either sand or the metal abrasives and occupies a floor space of but 45 in. x 51 in. and is 69 in. high.



Cabinet for operators protection

Using native ores, the first blast furnace for the production of pig iron for steel manufacture has begun operations in Natal.

Pneumatic Tubes in the Central Telegraph Office, London

Details of Equipment of One of the Largest Pneumatic Tube Systems in the World—Comparison of New and Old Methods

By ALEC B. EASON, M. A.

THIS article describes one of the busiest pneumatic tube systems in the world, the number of messages transmitted via 110 tubes being approximately 130,000 daily. The Central Telegraph Office, called C. T. O. comprises the major part of the General Post Office (West) lying at the corner of Newgate Street and St. Martins-le-Grand almost under the shadow of St. Paul's Cathedral. The various floors of the building are occupied with the various groups or divisions of telegraph offices generally as follows:—4th floor, metropolitan galleries where the wires from London offices terminate; 3rd floor, provincial galleries where the wires from the big provincial centres such as Liverpool, Manchester, Dublin, Edinburgh terminate; 2nd floor, foreign and provincial galleries where certain provincial wires and the lines from Paris, Antwerp, Rome, etc. terminate; there are also street pneumatic tubes from cable companies in this gallery; the 1st floor is used for offices; ground floor, where we find the terminations of the street tubes from the city and market telegraph offices, such as Stock Exchange, Billingsgate, Smithfield, etc. The delivery room from where the messengers take out the telegrams to the public, and the counter where the public hand in messages are also on this floor. The basement contains the plant for working the tubes.

The purpose of the house pneumatic tube system is to connect all these galleries and to provide rapid communication from point to point. To effect this fifteen distributing points have been chosen: tubes converge on and radiate from these, the principal points having ten incoming tubes from, and ten outgoing tubes to the other points. The location of the points is seen in Fig. 1. To simplify records and maintenance work, each point is given a distinguishing number; thus on the 4th floor we have tube table in the north-west corner = NW4 = No. 1, NE4 = 2, SW4 = 3, SE4 = 4, and on the 3rd floor NW3 = 5, NE3 = 6, Centre = 7 etc. Where the street tubes terminate on the ground floor is called "Central Hall" and denoted by 10; the delivery room is 22. Tubes are denoted by three or four figures; thus tube 2210 leads from the Delivery to Central Hall, 1022 leads from the Central Hall to the Delivery. Tube 71 goes from Centre to NW4, tube 17 leads from NW4 to Centre. The tube designation shows between what points and in which direction the tube is worked.

Fig. 2 may help the reader to understand the amount of circulation which telegrams undergo. It shows how a telegram handed in at Billingsgate for an addressee in Dublin is transmitted to Dublin. The message form is placed along with others in a carrier and travels via a street tube to Central Hall. An attendant takes the forms from the carrier and puts them on the circulation table; a clerk sorts them into receptacles labelled with the tube tables, (NW4 etc.): an attendant takes the forms from these receptacles and puts them in a wire basket just below the tube going to NW4: the tube attendant puts the messenger into a carrier and inserts it in the proper tube. When the carrier arrives at Centre it is emptied and the forms are placed on the circulation table: the clerk puts it in the receptacle, from which it is taken to the Baudot set, Wheatstone set, or other telegraph apparatus on which it is sent by wire to Dublin. The same type of circulation occurs in the Dublin office.

The C. T. O. tube system which assists in this circulation is similar in principle to that used in large stores and warehouses: but in the C. T. O. the traffic between the various points is considerable; in warehouses the traffic tends to be to the cashier or a central point and not from point to point. The tubes radiate from one point rather than cross connections between the various points.

The message forms are placed in carriers made of fibre, gutta-percha, or leather and the carriers travel in the tube. The message forms are not placed direct in the tubes as in the case of the Ticket Distributor used in some trunk telephone exchanges. Attendants usually put from five to twenty messages in a carrier and one attendant can deal with 200 to 250

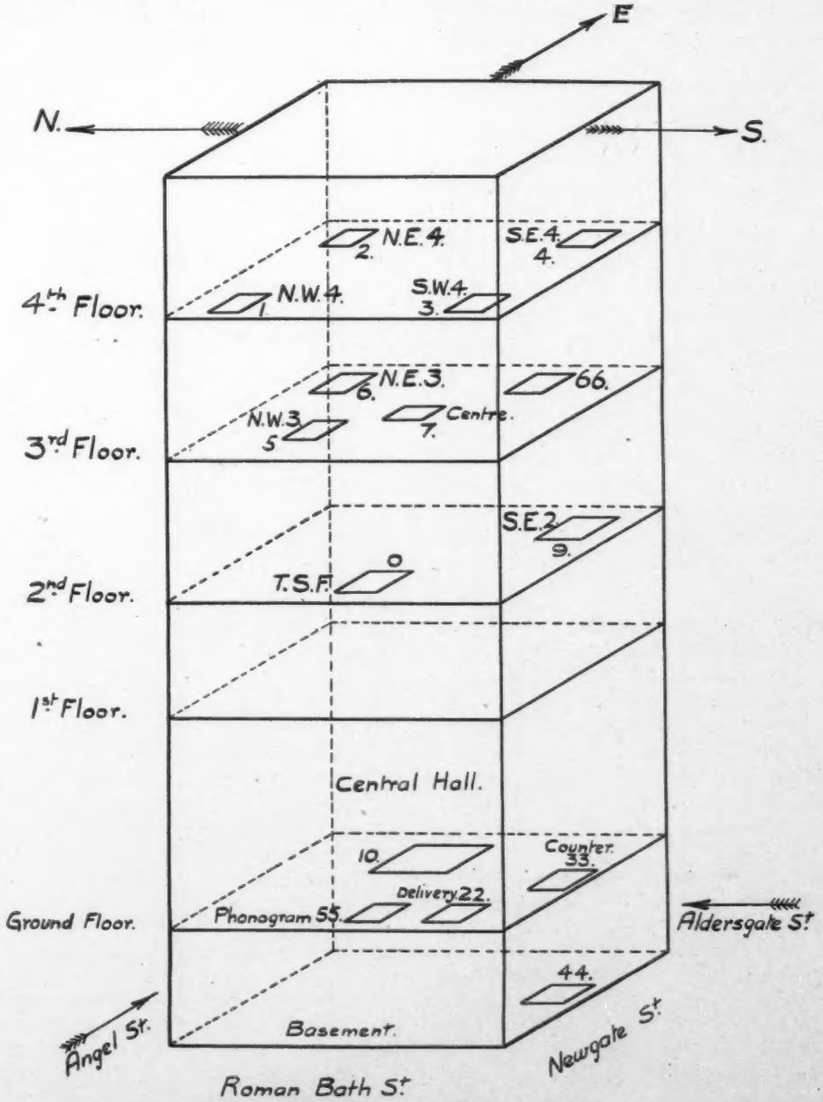


Fig. 1.—Showing location of principal distributing points.

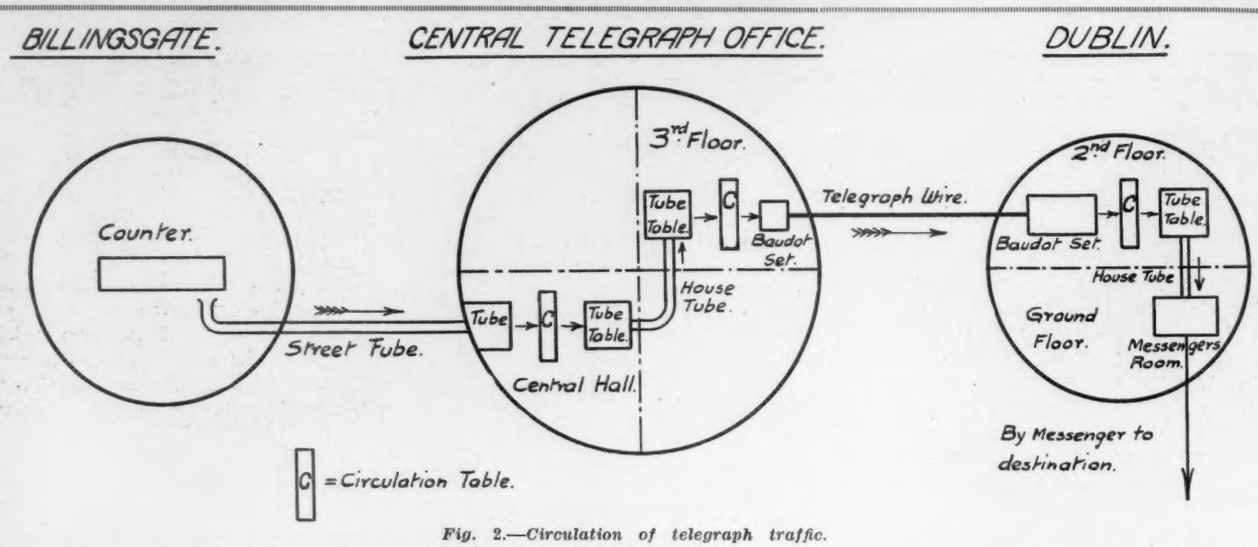


Fig. 2.—Circulation of telegraph traffic.

carriers per hour. In most tubes, carriers might be inserted every ten seconds, so that a tube, if required, could carry 7,200 messages per hour.

The system was erected in 1914 according to Post Office specification. It includes four and one-half miles of brass tubing, iron service pipes, and apparatus at the tube tables.

Apparatus for Inserting and Ejecting Carriers

At the open end of a tube, a "funnel terminal" is used: this is a plain bell mouth (see Fig. 4 and 7): in Fig. 7 the circulation table receptacles can be seen below the funnel terminals. At intermediate stations "despatch terminals" are used: a row of ten such is shown on the left in Fig. 11. One is seen on the right in Fig. 12: the attendant opens the aluminum door to insert the carrier: the vacuum in the tube holds the door closed. Carriers are automatically ejected by "flap terminals": these are seen on the right in Fig. 11 and 12. The vacuum holds the flap shut when it falls back under the action of gravity. The hopper (of 22 S. W. G. sheet iron) in front of the flap terminals directs the carriers into a spring net placed in a hollow in the table. When an incoming tube and outgoing tube are looped, the pipe from the flap terminal is joined to a T piece under the despatch terminal (see Fig. 11). Fig. 10 shows the back of the flap terminals at Centre: the three elbows which are visible join incoming tubes to outgoing tubes, which are fixed at the right hand of the table. The

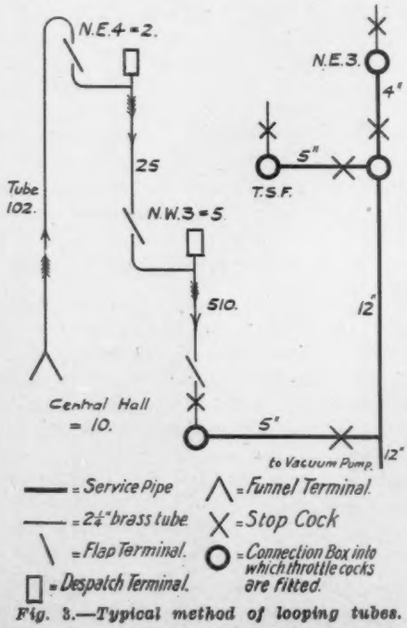


Fig. 3.—Typical method of looping tubes.

Fig. 4—Shows funnel terminals which consists of plain bell mouths

six prominent switches on the shelf are terminations of street tubes.

The method of taking outgoing tubes upwards instead of downwards is to be recommended. Fig. 6 shows table SE2, on the second floor, where most of the tubes go to floors above: Fig. 11 shows NW4 where all the outgoing tubes go to floors below. Outgoing tubes going upwards have this advantage: if the vacuum fails, carriers will not rise in the tube and the attendant sees the fault at once; if the tube goes downwards, carriers inserted in the despatch terminal fall by their own weight to the first bend and the attendant may insert four or five carriers without noticing the failure of power: when power does come on it may fail to dislodge the carriers and a tube fault is caused.

Size of Tubes—Service Connections—Power Used

The tubes are of brass, two and one-fourth inches internal diameter; they are looped together to form 500 to 700 feet loops (See Fig. 3). After the last flap terminal on the loop the tube is joined by one and one-fourth in. lead pipe to a one and one-fourth in. stop cock, screwed into a connection box, into which the vacuum service pipe is led. Fig. 5 shows the cocks on ten incoming tubes at Central Hall. Looping of tubes is resorted to in order to reduce the amount of air used: while the tubes are in use air flows continuously through them at the rate of one and one-half to two lb. per minute. The 110 tubes form 44 loops.

At the tube tables on the 4th floor every incoming tube is joined to an outgoing tube: in Central Hall all incoming tubes go to the connection box: on other floors some tubes are looped and some go direct to the vacuum supply. The vacuum in the brass tube between the cock and the flap terminal controls how much air will circulate in a tube. The one and one-fourth in. stop cocks enable this vacuum to be adjusted to suit the varying lengths

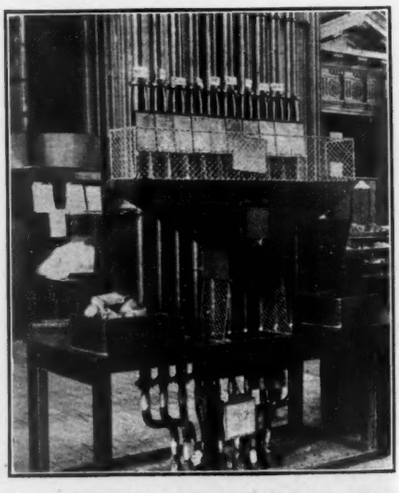


Fig. 5.—Shows cocks on ten incoming tubes at Central Hall.

Fig. 6.—Table S. E. 2 on second floor where most of tubes go to floors above.

Fig. 7.—Circulation table receptacles below funnel terminals.

designed, the vacuum available was more than was necessary and the throttling did not matter. For entirely new installations, full-bore services and cocks should be used and blowers used to produce the vacuum. At C. T. O. the air compressors which had previously been of loops. If all the loops offered the same resistance to the flow of air such adjustment would be unnecessary, but the flexibility of adjustment proved valuable at C. T. P. The use of one and one-fourth in. service pipes and cocks creates a loss of vacuum and should be avoided; but when the installation was used to work house tubes were available to work the new system and no blowers were installed. The vacuum is from three-fourths in. to two in. of water gauge per 100 feet of tube giving four in. to ten in. at the end of the loop. About one and one-half lb. per minute of air flows in each loop: with 44 loops this gives a total quantity of about 60 to 70 lb. per minute (800 to 900 cu. ft. free air). If the loss of vacuum in the service pipes was kept small a fourteen H. P. blower abstracting say 65 lb. of air per minute from three-fourths lb. per square inch vacuum would work the tubes: the air compressor takes about 30 H. P. The straight runs of tube are supported about every seven feet: on curves the supports are placed at shorter intervals. The complicated nature of the tube runs is seen in Fig. 8: the tubes passing to the right, drop down to the Centre tube table. Fig. 9 shows runs on the 3rd floor ceiling finishing just below table SE4: the tubes from this table are seen coming through the ceiling. The tubes on the right drop down to table SE3. When erecting curved portions of the runs, standard bends of three feet radius were cut to suit requirements. Straight tube was not bent on site, to avoid the chance of dents occurring in the tube: this is specially important at bends where the speed of the carriers is reduced. The average speed is sixteen to twenty-four feet per second.

Comparison of Old and New Methods

The C. T. O. house tubes were previously worked intermittently at relatively high pressure as if they were street tubes. The operations performed by the attendants were legion, viz: (1) open a receptacle in the tube, (2) insert a carrier, (3) shut the door of the receptacle, (4) turn on pressure, (5) turn off pressure when a bell gave the signal that the carrier had arrived at its destination. The time to perform these operations was a considerable portion of the "circulation" time: the quantity of air used was enormous: it was supplied at six and one-half lb. per sq. in. vacuum and ten lb. per sq. in. pressure. The leakage from cocks and doors was considerable. The quantity of air used in the old system was never measured, as there was no means of differentiating it from that used on the street tubes.

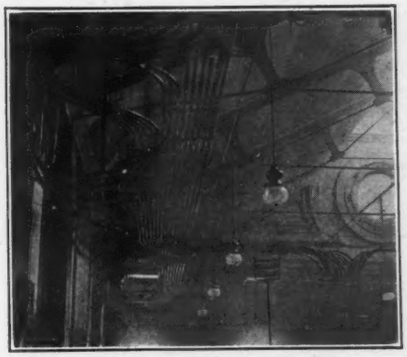


Fig. 8.—Shows the complicated nature of tube runs.

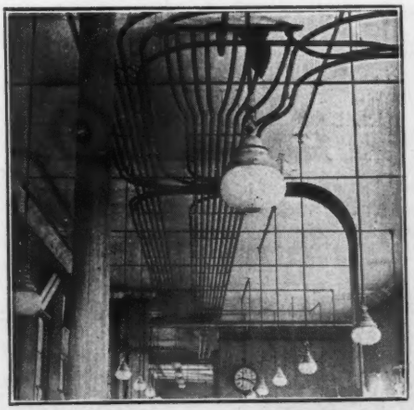


Fig. 9.—Arrangement of tubes along ceiling.

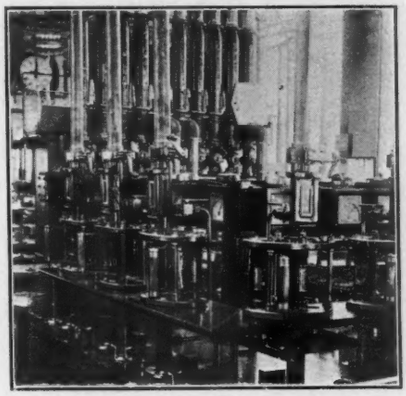


Fig. 10.—The back of flap terminals. Centre, third floor.

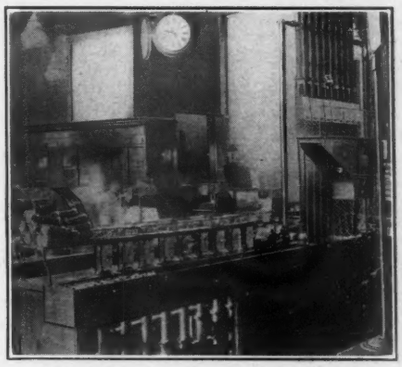


Fig. 11.—Despatch terminals are shown on left.

The new system was installed in 1914 and had 110 tubes in place of 50 worked both ways. The electric power consumed in driving the pneumatic tube compressors (street tube work included) first decreased from 60,000 to 55,000 units weekly. At that time the house tubes were worked from six and one-half lb. per sq. in. vacuum; 120 lb. of air were taken from the high vacuum instead of being taken from two lb. per sq. in. vacuum, which was all that was required. When additional pipework was installed it was possible to alter the scheme of working the compressors and to work from a lower vacuum: the units then fell to 45,000 weekly. The staff of attendants employed previously to work the 50 tubes has been decreased by about 30 to 40 per cent.: and the reduced staff easily work the 110 tubes owing to the simpler operations involved.

Kindred Information

Other details concerning pneumatic tubes can be found in the publications of the Institution of Post Office Engineers, G. P. O. (W), London, E. C. 1 and in the technical instructions of various governments. The writer discusses various questions in a book "Flow and Measurement of Air and Gases" (Lippincott). Kasten* describes the tube system, pick-up carriers, etc. of the new Berlin Telegraph Office: the house tube systems there are worked by low vacuum of one lb.

*Zeitschrift Verein Deutscher Ingenieur, Vol. 61, pg. 709:1917.

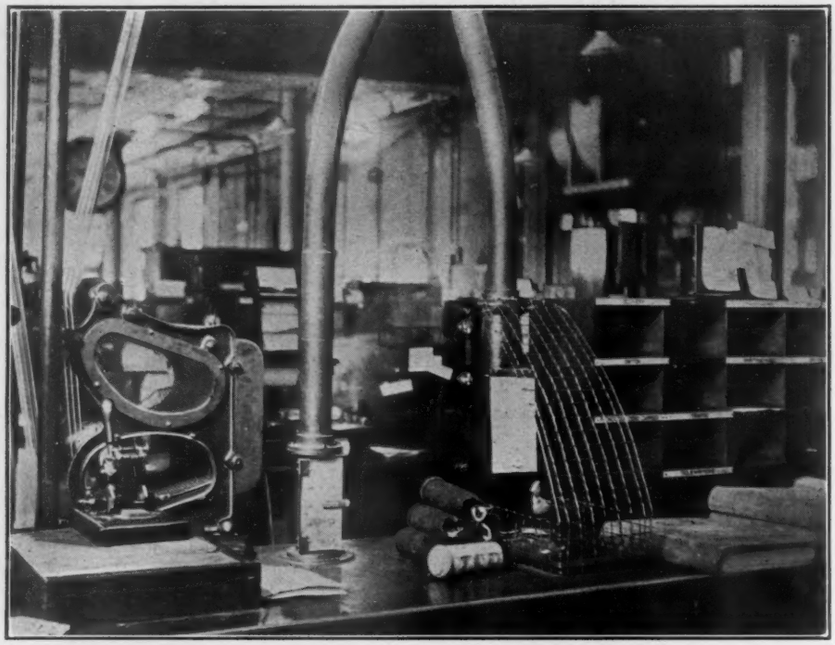


Fig. 12.—Showing flap terminals.

per sq. in. derived from blowers. There are only 23 tubes joined to form nine loops.

In conclusion the author wishes to thank the editors of the Post Office Electrical Engineers' Journal for permission to use Fig. 4, 5, 11, 12 from pg. 190, Vol. 7:1914.

AIR MACHINERY EXPORTS

The Bureau of Foreign and Domestic Commerce of the Department of Commerce, has provided for publication the following table of exports from the United States of air compressing machinery, by countries, in the last month for which records are available, February, 1920.

Countries	*Dollars*
Belgium	757
Denmark	240
France	189,690
Italy	4,602
Norway	6,097
Spain	71,980
Sweden	950
England	31,031
Canada	17,571
Guatemala	220
Honduras	533
Nicaragua	496
Salvador	156
Mexico	49,268
Jamaica	1,523
Trinidad and Tobago	67
Cuba	10,271
French West Indies	1,533
Brazil	5,560
Chile	8,081
Ecuador	72
Peru	9,139
Venezuela	165
China	8,127
British India	27,984
Other British East Indies	50
Dutch East Indies	2,001
French East Indies	30
Japan	17,407
Russia in Asia	2,540
Australia	11,599
New Zealand	3,286
French Oceania	346
British West Africa	4,053
British South Africa	6,953
Portuguese Africa	2,557
Total	496,935

IMPORTANT AIR WORK IN THE PAPER MILL

One of the most insistent requirements in paper mill operation is the constant removal of the vapors released from the traveling sheet as it is transformed from pulp to paper. All this vapor goes into the air of the apartment and in the proper treatment of this air is found the satisfactory solution, and one of its latest exemplifications is found in the mill of the Nuera Paper Company, as detailed in a recent issue of *The Paper Mill.*

In the machine room of this mill is installed in its completeness the Sturtevant Vapor Absorption System. Instead of the older method of blowing warm air on to the roof to absorb the moisture after it has been conveyed to that point, this system circulates the air right around the dryers of the machine. There is a big blower which draws air through a bank of steam pipes to warm the air. Then the blower discharges this air through pipes which lead to nozzle pipes. These nozzle pipes are so arranged that thousands of cubic feet of air every minute are blown into the pockets which hold the vapor given off by the paper. This air absorbs the fog as fast as it leaves the wet sheet so that no sign of steam can be seen.

It is a peculiar sight not to see a trace of fog rising from a paper machine. The Nuera Paper Company expect that this system will prevent all fog and drip from the roof and that the efficiency of the machine dryers will be so increased that they can greatly increase the tonnage taken from the machine. It will also enable them to dry their paper at a lower temperature, which will mean securing a better quality of board.

A pipe is taken from this blower and warm air is discharged into the machine and repair shop. This will not only heat it comfortably but will ventilate it at the same time.

Air is also blown along the roof at the wet and finished end of the machine room to prevent the damp air condensing in these parts of the room which are usually colder than just over the dryers.

By thus blowing in a good supply of warm air into the room, the objectionable inward rush of cold air through doors and windows is eliminated. When the ventilators on the roof draw the air from the room unless warm air is supplied to take its place, the air must come cold from outdoors with consequent fog. To prevent this, doors and windows are often kept closed, yet everyone knows a good circulation of air is necessary if production is to be maintained. This company evidently intended to get the right conditions this winter.

Then there is another blower and heater to supply air to the beater room. Pipes are led from the blower and are carried along the ceiling of the beater room. Some of the air is blown along the roof to keep it from condensing the moisture. There is vapor rising from the beater as hot water is used. Some of the warm air from the system is discharged towards each beater so that this vapor is absorbed as fast as it rises. Even in cold damp days the beater room is kept warm and dry. It should be easier for the Nuera Paper Company to keep good men when they have provided these ideal working conditions for their employees.

STEEL CONTAINERS FOR LIQUID AIR

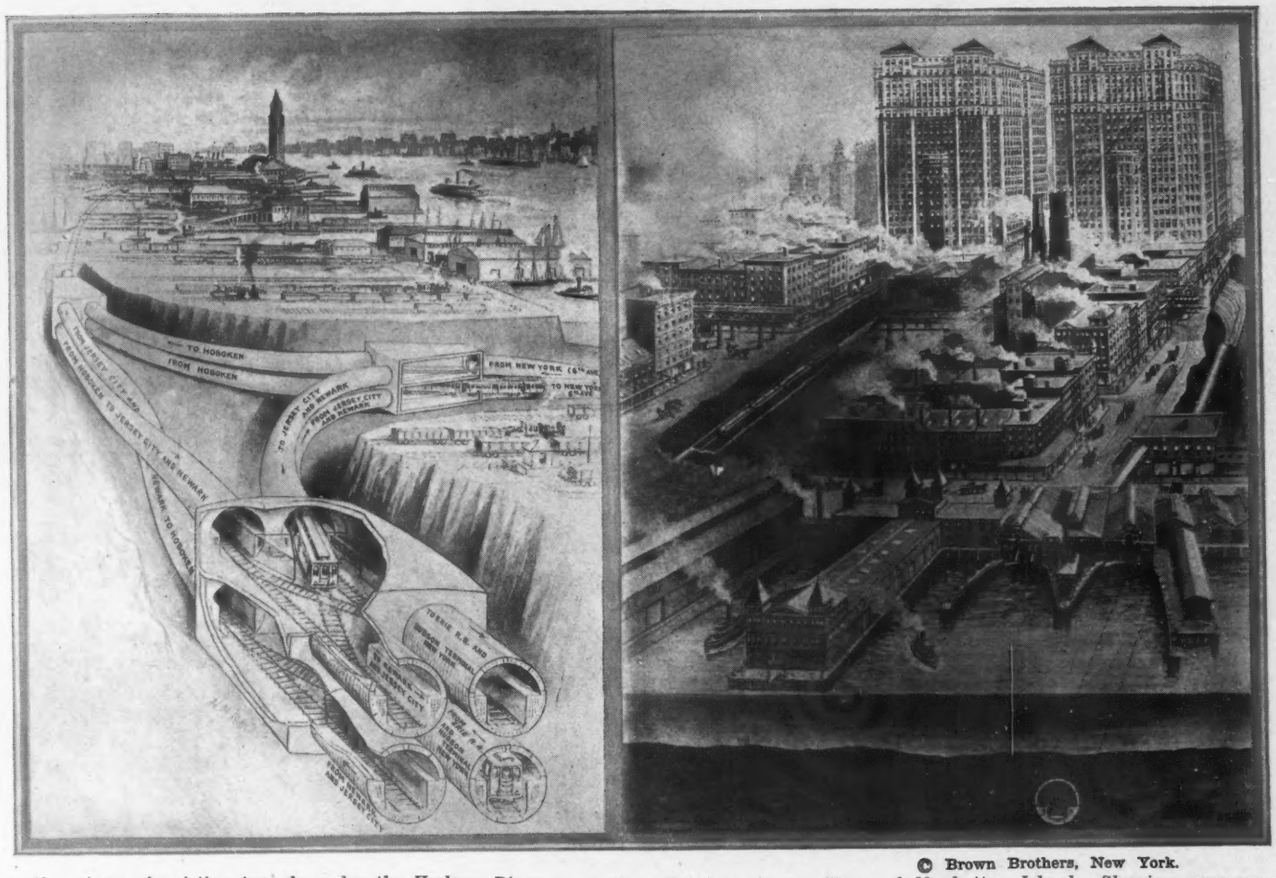
In a paper on "Rescue Apparatus Problems," read at Chesterfield, England, before a conference on Rescue Work in Mines, Professor Briggs pointed out the defects in the flasks used for containing liquid air, which in the past have been supplied by Germany. It will be understood that these flasks are used for conveying liquid air in considerable quantities. They each consist of a double shell with a vacuum space between, the liquid air being contained in the inner shell and subject to atmospheric pressure only.

All the joints, of which there are six, are of the simplest kind, made by soft solder, and the least failure of any of the six destroys the vacuum and spoils the flask. In view of the fact that the weight of the inner globe, plus perhaps 50 lb. of liquid air, is hanging by a thin neck from one point of support, and that the security of the support depends altogether upon the solder, the German container leaves much to be desired in the way of mechanical strength. Professor Briggs said that he would prefer a container made all of steel, with thoroughly strong joints, in which the strength depends upon the metal itself instead of upon the solder, and where solder only serves as the sealing medium. To increase the strength, the neck should be shortened. Such a construction would add to the evaporative loss of the bottle, but it would be worth while to put up with a slightly greater loss if the flask becomes a serviceable and robust article. Another problem of the container relates to the use of charcoal in the vacuum space as a means of promoting a high vacuum, since it has been proved that, if the flask is pierced and if the liquid comes into contact with the charcoal, an explosion may result.

Compressed Air vs. Trench Method for Hudson Tunnel

Construction by Trench Method Apparently Impractical Under Present River Conditions—Shield Method of Driving, a Proved Success

By E. P. McCRORKEN



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Perspective views of existing tunnels under the Hudson River connecting Hoboken, Jersey City and Manhattan Island. Showing arrangement of tubes at terminals.

THE BUILDING of the proposed vehicular tunnel to provide subaqueous transportation across the Hudson River between Manhattan island and the state of New Jersey has presented a number of complex engineering problems requiring for their solution, the ablest engineering brains and experience in tunnel building.

The commissions have retained a staff of eminent engineers as their advisors, men who have been connected with the most important undertakings of today and who have had many years of tunnel experience.

The board of consulting engineers is composed of Col. William J. Wilgus, Chairman, J. V. Davies, Prof. William H. Burr and Maj. J. A. Bensel. C. M. Holland is chief engineer of the tunnel commission, J. B. Snow, chief assistant and N. Froelich, secretary.

Both the board and commission engineers have had under consideration the trench method and shield method of construction. In fact, it has been recommended that the commission proceed with the preparation of contracts, plans and specifications for the shield method of driving the tunnel, which will consist of two 29-ft. cast iron tubes. The shield method has so far been the common method used and has proved to be entirely successful in all instances. Furthermore, it is recommended that the study and consideration of using the trench method be continued with a view, if later decided to be practical and cheaper, to ask alternative bids for this method of construction.

Two factors stand out prominently in making such a decision:

First, can such a trench be dredged?

Second, what danger of accidents exist in using such a method?

The only trench-constructed tunnel of similar diameter in existence is the Michigan Central tunnel across the Detroit River. The method here proved entirely successful but the conditions under which this tunnel was constructed do not obtain on the Hudson.

Briefly, using the trench method would consist in dredging out a cut in the bottom of the river 68 feet deep and 80 feet wide. The pre-cast reinforced bulkhead concrete section would be towed out and sunk into the trench.

The advantage of this method would consist in using the cheaper labor employed on the surface of the river over the higher priced men working in compressed air used in the shield method.

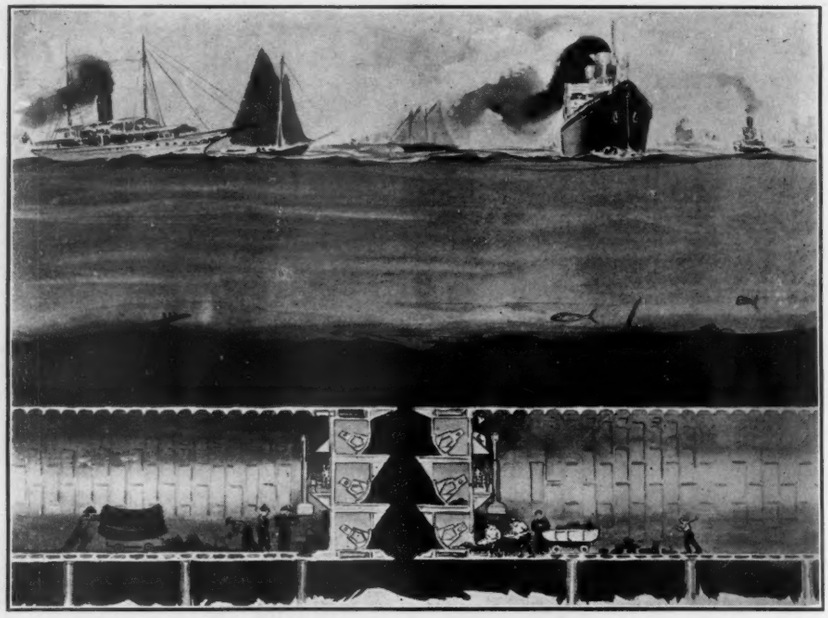
The present rates of the Sand Hogs Union are as follows:

Hrs. Worked	Pressure	Wage per day
8	0-22	$8
6	22-30	8.50
4	30-35	9.
3	35-40	9.50
2	40-45	10.
1	45-50	10.50

The pre-war rate for all pressures was $3.50 per day for all pressures.

Consequently the present high rate of wages for sand hogs is an important consideration although the savings estimated by the trench method would not amount to more than about 10 per cent., and if dredging conditions proved to be more difficult than normally is to be expected, and it is entirely likely they will, this saving would entirely disappear.

In dredging out a channel 80 feet wide and 68 feet high in the silt bottom of the Hudson the question of slope looms up in large pro-



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Cross sectional view of tunnel being driven by the compressed air and shield method

portions. The engineers' report has this to say on this point: "The depth of water required by the War Department in the Hudson River necessitates dredging operations to a depth of 90 feet below mean high water. This will require a maximum cut in the river bed 68 feet deep, where the softness of the Hudson River silt makes the question of the slope at which the sides of trench will stand problematical."

In fact, the commission says that there are no figures or other data available from which even an approximate idea can be obtained of the required slope of the sides of such a trench.

Character of Hudson River Silt

A report from General Goethals to the Bridge and Tunnel Commissions as published in the Eighth Report in 1918 reads as follows:

"The material through which the trench must be dug is soft silt and mud. Some idea of the fluidity of the material may be had from tests made by dropping a pole 48 feet long, weighing 55 pounds, of which 38 feet was of wood 2½ inches in diameter, 10 feet of ⅝-inch diameter steel; under its own weight it penetrated the material to a depth of from 27 to 36 feet. The upper strata in close proximity to the water, is in such a liquid state as to be set in motion by the passage of deep draft vessels. It is true that the material becomes more compact at the greater depths, yet it is equally true that water admitted to the lower strata reduces these to the same consistency as the upper strata. . . . It is a significant fact that while making the borings to rock, no drive samples could be secured at any depth through the silt and mud. . . . It (the silt) overlies the rock as an unstable mass, affected by tidal fluctuations and temperature changes."

Further information it is suggested can be obtained from the report of General Raymond to the Pennsylvania Railroad in 1911. Here it is stated that Hudson River silt is a material approximating a fluid in its action and admittedly at some places approaching a fairly stiff clay, but in designing a tunnel to meet Hudson River conditions we must meet the worst conditions and that is that of a semi-fluid condition.

It may thus be seen that dredging out a trench across the bottom of the Hudson is a decidedly doubtful proposition.

The second factor to be considered in the adoption of the trench method is the possibility of accidents from collisions occurring during construction.

The Hudson River traffic is exceedingly heavy. There is not only through traffic bound north and south but cross river traffic going east and west. This condition does not prevail to any such extent on the Detroit River to which reference has been made in connection with the building of the Michigan Central tunnel by the trench method. A report received from the United States Engineers' Office shows that two dredges working in the East River suffered 62 accidents during 1918 and 1919. Five accidents caused delays from five and one-half to 46 days each.

The consequence of a collision occurring while lowering a section of the tunnel into the trench causing it to be displaced might be a delay of months in order to remove it say the commission engineers.

It would therefore seem that the final choice of using either the shield method or the trench will favor the former, which has been tried out in the East River tunnels and also in the existing Hudson River tunnels and has proved to be entirely practicable. However, the Board of consulting engineers point out the fact that they have not yet closed the door entirely upon the trench system. They still claim to be open-minded upon the subject but until further information is to be had upon the doubtful phases of this system it will not be recommended.

Ventilation of Tunnel

An investigation of air conditions inside the tunnel is being made by the U. S. Bureau of Mines. Owing to the exhaust from gasoline motors it is important that steps be taken to renew the air as rapidly as necessary. It is intended to have a fresh air inlet compartment along the bottom of the tunnel and a similar outlet compartment at the top. Ducts connecting both of these compartments at frequent intervals with the center chamber will then be installed and fresh air pumped in by fans.

Dr. Yendel Henderson of the U. S. Bureau of Mines has carried on experiments to determine the minimum amount of carbon

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Pennsylvania R. R. tunnel under Hudson River. View of shields during dismantling after having met. Showing front edges of skins in contact.

monoxide in the atmosphere which will have an injurious effect upon the human system. Other experiments are being made at the Pittsburgh station of the bureau to determine the volume of exhaust gases from the exhaust of a motor and their composition. It will then be possible to obtain some quantitative idea of the amount of fresh air necessary to make the tunnel safe.

The magnitude of the ventilation problem can be realized when it is understood that the tunnel will be 5,400 feet long between shafts placed just inside the pier head lines and it is estimated that about one-fifth of the tonnage of freight which crosses the river on lighters every day will come through the tunnel.

The estimated traffic seeking the tunnel in 1924 is 5,610,000 vehicles while the capacity of the tunnel is estimated to be 15,800,000, or nearly three times the demand at the time of opening. The estimate of traffic has been criticised as being entirely too low, but no figures disproving those which have been worked up after careful study by the engineers of the commissions have been produced so that these criticisms are merely statements of unsupported opinion. The estimate of traffic to the tunnel has been arrived at after a careful study of the growth of traffic over the East River bridges and over the Hudson river ferries during the past six years. The growth of traffic over the East River bridges during a similar period is the best criterion which can be obtained as the basic for forecasting traffic. The East River bridges furnish ample and uninterrupted means of communication across the East River, providing for the needs of traffic as fast as it develops.

COMPRESSED AIR BURNERS HAVE MANIFOLD USES

Much has been said about the burning of oil, but little about the successful burning of oil. This depends entirely upon the burner. To burn oil successfully, it must be perfectly atomized. By that is meant the breaking up of the oil into fine particles, and each globule to be supplied with the necessary oxygen for combustion. When this is done, there is absolutely no loss of heat, and every heat unit contained in the oil is utilized.

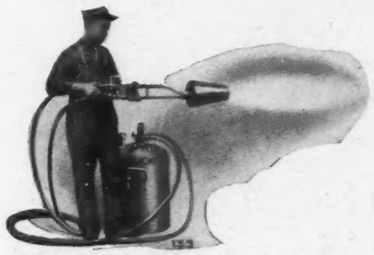
One of the most satisfactory ways to do this is to use compressed air as the atomizing agent.

One commercial type known as the Hauck Compressed Burner as well as Furnace Burners, are so designed that the oil is perfectly atomized in the nozzle of the burner by compressed air from 20 to 100 lb. pressure. These burners give the maximum amount of heat with a minimum consumption of oil. This in itself is an important factor.

The portable type of compressed air burner shown in figure 133 is made in six sizes and burns any grade of kerosene, fuel or crude oil. The burner will work satisfactorily on any air pressure from 20 to 100 lbs. and, the average air consumption ranges from 20 cubic feet of free air a minute for the large size burner, to five cubic feet for the smallest size.

These burners are used for many different classes of work wherever an intense heat is required. Temperatures up to 3000° F. can be obtained with them. They light instantly with a match. Flame is instantly regulated and when they are properly designed, the burners do not carbonize.

A strongly built two wheel truck so that the



For burning any grade of kerosene, fuel or crude oil

outfits can be moved about freely can be obtained.

In foundries for instance, burners are used for lighting cupolas, drying molds, heating and dry ladles, heating core ovens, and other work —in every case showing a great saving in time and labor.

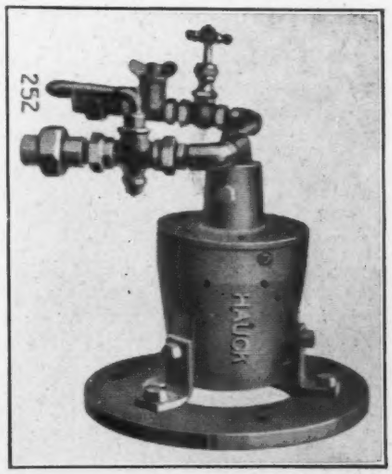
Machine and repair shops use the same type of burner for expanding to make shrink-fits; straightening, brazing, preheating in connection with welding and other uses.

Boiler and pipe shops use them for laying up corners and seams; for shaping throat sheet work; annealing, bending, pipe flanging, laying up patches, straightening, buckled sheets, heating sagged ends, etc.

In the shipyards, they are used for removing propeller blades, straightening girders, beams, hull plates, tail shafts; reshaping, annealing armour plates, etc.

These are only a few of the many uses to which the compressed air burners can profitably be put. It would be impossible to enumerate them all. But in any industry where intense heat is required, a burner can be advantageously used with great economy in time, labor, and fuel.

Figure 252 is a Hauck furnace burner which



Operates with compressed air from 20 to 100 lb. pressure

operates with compressed air from 20 to 100 lbs. pressure, and atomizes fuel, crude or kerosene oil. For such work as heating boilers for raising steam, heating core ovens, heating annealing and case hardening furnaces, tempering furnaces, large tanks; autoclaves, kilns of any description, sintering furnaces; for rivet and bolt heating furnaces, etc., burners are extensively used. The burners do not rely upon the construction of the fire brick walls for combustion, as complete combustion of the oil and air takes place in the burner nozzle. Only a perfectly developed flame enters the furnace. It is a simple matter to install the burner as each comes mounted on a flange with bolt holes ready for attaching. Proper space allowance is made for a natural suction draft.

The air consumption of the large burner forges is about 20 cu. ft. of free air per minute, while that of the smallest burner is 5 cu. ft. of free air per minute. The flame produced in these burners is clean, intense, and powerful, without spitting or wasting of oil. The temperature can be instantly regulated.

Where heavy Mexican or California petroleum is used, or where the air line contains water, the burner is supplied with a preheating attachment.

Another type of burner which operates with compressed air and is known as the low and high pressure type of burner is similar to the regular high pressure type of burner except that an additional fan blast of six ounces is required to complete combustion.

Operates without pressure on oil tanks by using siphon arrangement

The immense volume of heat produced by the burner makes it especially suitable for large forging furnaces.

Fig. 342 is a new torch which operates with compressed air, but without pressure at any time on the oil tanks as the oil is siphoned to the burner. The torch is absolutely safe. The maximum air consumption of the burner is five cubic feet of free air per minute. The burner lights instantly without preheating. It has a special attachment for controlling the oil so that after the flame is once regulated to suit the requirements the oil control is locked into position. Then, when the torch is used again, it is not necessary to regulate the oil, as it is set to start immediately with the required flame.

As the burner will operate with fuel or refuse oil, garages in particular have found this torch useful for their work.

What is probably the largest refrigerated cargo that ever entered at the port of New York arrived here recently from China by steamer *Albion Star* of the Blue Star Line, consigned to the National Cold Storage Company. The cargo consisted of Chinese canned eggs and other refrigerated foods partly destined for transshipment to foreign markets.

Why the Blueprint?

*By FRANK RICHARDS**

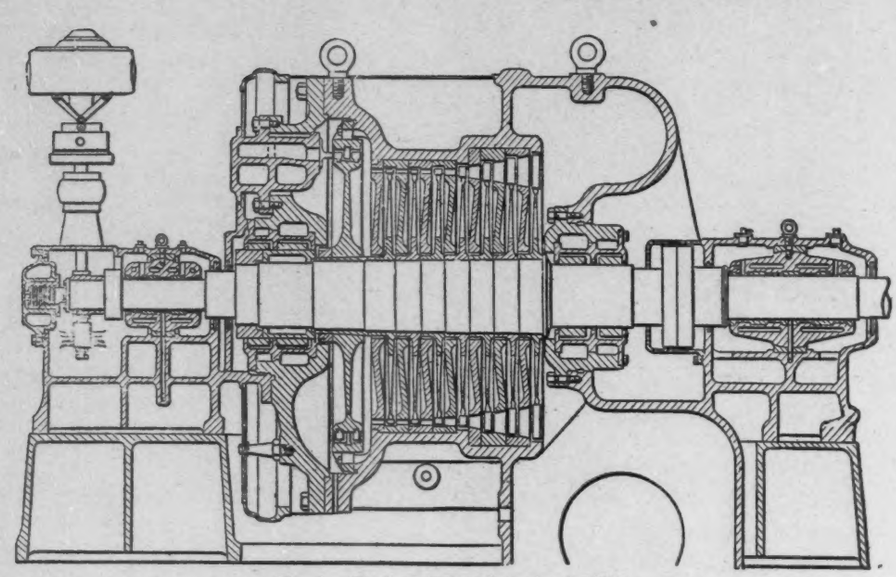


Fig. 1.—Post-card drawing of a turbine.

W. D. FORBES, on page 182 of the *American Machinist*, locates the first suggsetion of the blueprint process away back in 1790. That may be the first suggestion to be found in print, which I doubt, but light printing dates far back of that. Last summer I saw several beautiful prints of lace upon the arms and breastworks of fair ladies at the beach, and such sun-printing must have been going on in the days of Cleopatra, only that her skin may have been too dark for satisfactory results. The perfected process was waiting through the ages for the coming of the modern chemist.

The present talk about the blueprint seems to make an opportunity for me to say a few words about a matter that I have been thinking of intermittently for a long time. The blueprint was surely a godsend to almost the entire industrial world. It came upon us all at once, as you might say, about half a century ago, fully ready for work, and it found immediate and universal appreciation and employment. It never required and never had any advertising or any pushing save what it did for itself. It has never been to the interest of any individual to either advocate it or oppose it; since, on the one hand, it displaced or superseded nothing, there was no great business to be developed in connection with its introduction, and no education was required as to its manipulation. Today, its use extends all over the world and to all industries dependent upon graphic and dimensioned delineation. Forgetting what preceded it, we could well ask how we ever did without it, and in the present and for the future it would seem to be equally indispensable. It is about the last thing that any one would ever think of as superfluous.

Yet the blueprint, it must be confessed, has never been altogether satisfactory in any use we have put it to. It has never been a thing that any one has ever thought of treating with any respect in the handling. Neither the blue surface nor the white lines are what they should be, and the printing gives neither fineness nor clearness of line, and if the lines are crowded they blur and confuse each other. To compensate for these deficiencies of the blueprint it must be made larger and less easily handled and studied than would otherwise be necessary. It is a crude, rough product at the best, not demanding a respectful treatment and not suggesting strenuous effort to keep it clean and smooth.

I certainly could never have the hardihood to suggest that the blueprint is ever to be discarded, but I do venture to propose some lightening or dividing of its tasks. Without more ado I here call attention to Fig. 1, and it makes no difference to us here what it represents. It will at least be recognized as most likely to have made its first appearance as a blueprint, and as such it was probably not less than 30x20 in., and perhaps considerably larger. The cut as here presented shows every line of the drawing with perfect distinctness and must certainly be as clear and legibile at every point as the blueprint. It can be seen more comprehensively as a whole at a single glance. As here reproduced it is a little less than the size of a post card, and its total area is less than 3 per cent. of the blueprint area as above assumed. Why should I have any hesitation in asserting that for all the purposes for which the blueprint could or would be used, this black on white post-card drawing is much to be preferred? If not, why not?

Fig. 2, to which attention is now called, is a dimensioned working drawing of the steel frame of a standard railroad car. It is not a drawing prepared for my purpose, but one that I have picked up from some technical publication which I neglected to identify, and it is here reproduced without change. This cut is also within post-card size, and the scale of it is about six feet to one inch. It might have been reproduced precisely to that scale, or to any other as most convenient. The written dimensions, while as legible as could be expected, might have been made larger and heavier if the post-card reproduction had been in view when the drawing was made. Now, what could the big blueprint tell anyone that the post card does not tell, and is not the post card handier and everyway to be preferred? Again, if not, why not?

Fig. 3 may serve as another suggestive illustration. This is a drawing of a chimney more than 200 ft. high with all the dimensions. No one needs to be told how big and unhandy would have been the blueprint which this little cut completely reproduces.

The post-card shop drawing, if it should ever make a go of it, must shove itself along, just as the blueprint has done upon its merits alone and with no effective help outside itself. It is easy enough to turn it down immediately by suggesting the prohibitive cost of the scheme, and this is where a big sur-

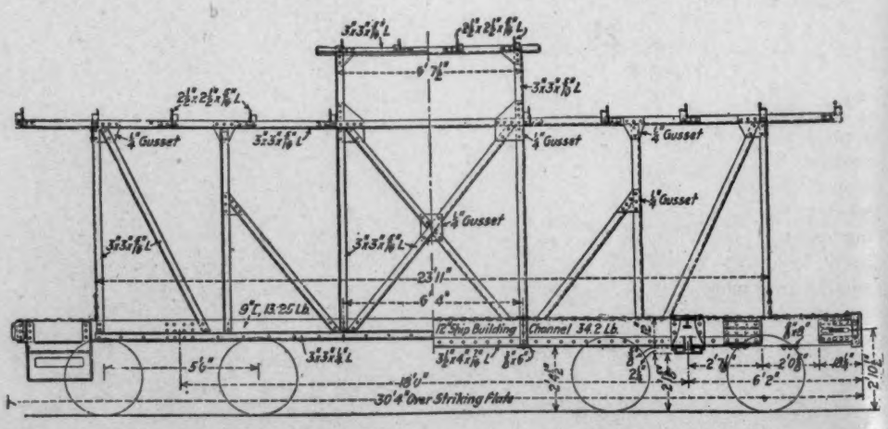


Fig. 2.—Post-card drawing of a freight car.

*Technical Editor of Compressed Air Magazine, in The American Machinist.

prise is lurking. The most astonishing thing is really the cheapness of it as compared with the business value of the result to be accomplished.

Probably few who have not looked into it fully realize how cheap and quick and handy is the zinc process of photo-engraving. We know in a general way that all the pages of a big dictionary and of entire, many-volumed encyclopedias have been reproduced by it, and how, when the printers' strike was on in New York, the pages of the *Literary Digest* and other papers were first typewritten and then photo-engraved for the printing; so it could not have been a prohibitively costly operation.

The process is awaiting the demand of the drafting room and is capable of working quite

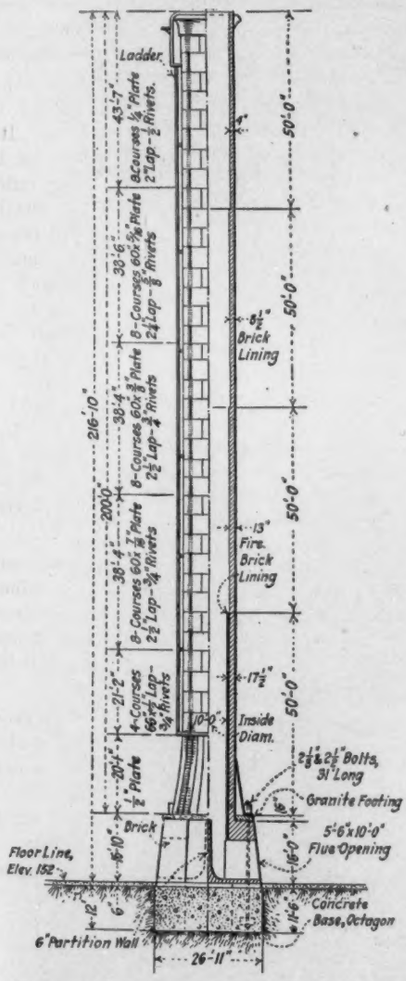


Fig. 3.—Post-card drawing of a chimney.

a revolution there. I think I have now in the process of writing this article sufficiently braced myself to enable me, notwithstanding what I said farther back, to suggest the giving up and abandoning of the blueprint entirely. See what would follow at once. There would be no more tracings, and only carefully finished line drawings which the draftsman could take pride in. These would be of any size most convenient for the working of the details, the photographing process ignoring the size of the original entirely and reproducing to any scale or size that might be desired.

For our convenience here we have been carrying in our minds the post-card size, and that would seem to be large enough for the standard working drawings of a shop, but from the same drawing any other size could be produced with equal facility, up to, say, a square foot of area, which should be large enough to show all the lines clearly that would be practicable on the largest blueprint.

Assuming that the process which we are urging should find favor and should become the established practice, every big concern would naturally have its own photo-engraving equipment as a detail of its drafting department, and this should soon displace the blueprinting arrangements and drive them out entirely. The blueprint would cease to be, not only as the working drawing of the shop, but also as the unwelcome accompaniment of specifications, proposals, contracts and other responsible documents. In place of it would be the neat little cut which might not even require folding, and which one would instinctively stick in his pocket for preservation instead of throwing it away. In the literature—pardon the word—of business solicitation, the line cut would often be welcomed and studied where the blueprint would be discarded without a look. The paradox would result that the field and function of the blueprint would be extended by its extinction.

It would be a simple and easy job to make a trial of this thing. Select some standard shop blueprint from your lists and send the tracing of it, if there is no finished drawing, to any of the zinc-process engravers and have a line cut made of it within the post-card size. It might be that the lines would not be of the most suitable thickness, or dimensions and written matter not large enough for the reduction required, and this would supply points for making a second drawing correct in these particulars which a second cut would verify.

The making of the first cut or two would also at once begin to bring information as to the cost of the process. The cost would of course all be in the making of the cut. Each copy printed from the cut would cost less than one-tenth of what each blueprint from the same tracing would cost, and would be of much more practical value. With the process fully established in a large works and all facilities provided, with reliable skill in the manipulation, the making of original cuts not larger than post-card size should cost not over one dollar each. This is not mere guesswork but is deduced from information which I am not at liberty to make public.

There are details of practice that would develop which it is not necessary to speak of here. For instance, the cuts when completed are metal plates about one-eighth inch thick, and these plates are mounted on blocks of suitable thickness to make the same height as standard type, but for the purposes here contemplated it would be better not to mount them on the blocks at all but to print from the thin plates. This would save time and cost in preparation and also enable the cuts to be stored more compactly.

We ought to hear at once of some enterprising individual going to work and making an actual start on this thing. If not, why not?

LOCALLY MADE VS. MAKERS' ROCK DRILL PARTS

By D. E. DUNN

A COMMON fallacy of rock drill users is to think that locally made rock drill parts are economical. It is granted that sometimes their initial cost is less—not always, when all the factors are taken into consideration. However, cheapness is not economy, especially in machine parts.

The operator will naturally have made those parts which wear most rapidly. In the hammer drill these are the side rods or through bolts, the through bolt springs, and pistons. If one will give the matter a second thought, he will realize that it is these parts that have been the subject of the greatest study of the rock drill manufacturer and that, in a way, the latter's success depends upon his finding and using the best material and special methods possible in their production. However, the same man who will deride the idea of bringing in a metal miner to operate his coal beds—and rightly—will in turn instruct his blacksmith or machinist to make parts for a highly specialized machine.

Three cases come to my mind as this is written of the operation of locally made parts. The first occurred in the Joplin Lead and Zinc district. The operator decided that his blacksmith could make just as good through bolts as the drill manufacturers. The finished product looked as good and he was highly elated for a time. Finally a representative of the drill manufacturers persuaded the operator to run an exact test. After a severe trial it was found that one bolt made by the drill manufacturers lasted as long as 35 locally made bolts. But the difference in cost between the 35 locally made and the one manufacturers' made bolts was the smallest item of the cost to the operator.

The operator was amazed when he analyzed the complete cost including the valuable time lost while the drill was being taken out to the shaft, brought on top, repaired and returned to the working place. He soon "saw the error of his ways."

A similar case occurred when an operator attempted to make "Jackhamer" pistons. In this instance, the operator was not satisfied with trying to duplicate the piston—which he later found impracticable, to say the least—but he wanted to improve it. He naturally saw that the pistons wore most on the striking face. After this face had been ground down several times, the piston was useless because the flutes would disengage from the rifle-nut on the back stroke. Then, on the forward stroke, the male and the female flutes would not match and the piston would hang up and the drill stop.

It immediately occurred to him to make the piston a little longer, thereby leaving more metal to be ground off and so increasing its working life. The valve on the "Jackhamer" is of the "Butterfly" type. It is thrown by unbalanced pressure built up at the end of the piston stroke. The lengthening of the piston shortened the stroke and did not permit the valve-throwing pressure to build up when the

drill was held down upon the steel. The operator alternated a while between trying to have the drill run when held down on the steel and holding the drill up a little from the steel. In the first instance, the drill would not operate; in the second, the drill broke the pistons—due to incorrect composition of material and improper heat treatments—as well as the side through-bolts, springs, and front heads when the piston struck the front head due to being held too far off the steel. He soon decided that manufacturer's parts were far more economical.

Another operator thought that the front washer for the Leyner drills could be easily and cheaply made locally. This was done and resulted in poor action of the drill as well as greatly increased air consumption. The maker was satisfied to harden after a finish cut without grinding.

Locally made parts usually result in erratic and unsatisfactory drill operation, the exact causes of which are sometimes difficult to ascertain. But the poor operation is always blamed on the drill, never on the poor part.

Needless to say, the majority of those who have used locally made parts soon found their mistake and the next time a part was needed it was ordered from the manufacturer. The best way to discover the relative costs is to equip two or more drills with locally made and manufacturer's made parts. Have all other conditions (air pressure, steel, operation skill, rock conditions, etc.) affecting the drills as nearly identical as possible. Run a complete test (drilling speed, air consumption, ease of operation, etc.) then thoroughly analyze the test records, giving each cost factor its proper consideration.

COMPRESSED AIR TRANSPORT FOR POWDERED COAL

BELOW IS presented a diagrammatic sketch of a powdered coal handling system soon to be installed at the Mount Vernon Street power plant of the Philadelphia Rapid Transit Company. The key which accompanies the sketch here reproduced from *Electric Railway Journal*, makes it practically self-explanatory.

The Quigley system, of which this installation is typical, differs essentially from the screw conveyor and high-pressure systems in that the fuel is transported in bulk from the pulverizing plant by small steel pipes without the use of return piping. It is not carried in suspension, but is similar to liquid flow.

The fuel is dumped from a car located on the siding and, after passing through a crusher is elevated to a magnetic separator where the tramp iron is removed. It then passes to the crushed fuel bin, from which it is automatically fed to a rotary drier and then carried by a bucket elevator to the dry fuel bin. Then it goes automatically to the pulverizer and the pulverized fuel bin.

From this bin the pulverized fuel is fed into the blowing tank, a quick reading scale indicating the amount in the tank. The fuel thus automatically weighed is forced by compressed air in proper quantities through the transport bins. The fuel supplied to each burner is governed by a controller with hand wheels. Combination air is regulated by a blast gate.

The fuel pulverizing plant may be located at the point most convenient for the fuel supply and the powdered fuel can be economically distributed to furnace hoppers at widely separated points. Delivery has been effected by this method for distances exceeding 1,500 ft. The Quigley Furnace Specialties Company has a record of 2,800 lb. of pulverized fuel having been carried 600 ft. through a 4-in. pipe in one minute under the air pressure averaging 15 lb. gage.

From the furnace bins the fuel passes through a dust-tight gate into an especially designed fuel feed controller, which regulates the fuel feed into a low pressure siphon. This siphon carries it, with about one-seventh of the air necessary for combustion, into the burner, where it is mixed at very low pressure with the quantity of air necessary.

A feature of interest is the blowing-tank unit, which consists of special equipment for storing, feeding and weighing the powdered fuel and transporting it to the points of consumption.

The tank is of cylindrical steel construction, and it is connected with the pulverized-fuel bin my means of a flexible connection. A control gate located immediately below the bin is now operated from the floor.

A valve in the head of the tank admits the pulverized fuel in any quantity desired and is operated by a conveniently placed lever. As mentioned before, the scale upon which the tank is mounted is provided with a quick-reading dial. When the desired amount of fuel has been let into the tank, the charging valve is closed, compressed air is admitted and a shut-off valve on the transport line is opened.

The controller consists primarily of a cast-iron box containing a feed screw, driven at constant speed by a gear or pulley, and adjustable shutters operated by a handwheel which give a suitable opening, under control, leading to the discharge head.

KEY TO LETTERS ON DIAGRAM

a	Coal car	m	Return air pipe
aa	Track hopper	N	Pulverized fuel bin
b	Regulating feeder	O	Fuel bin gage indicator
A	Coal crusher	P	Dust-tight gate
bb	Chute	p	Hand chain-wheel
B	Elevator	pc	Hand chain
c	Hopper	Q	Blowing tank
cc	Conveyor	Qa	Compressed air supply
C	Magnetic separator	q	Flexible connection
d	Reject pipe	R	Inlet valve
D	Crushed fuel bin	S	Scale dial

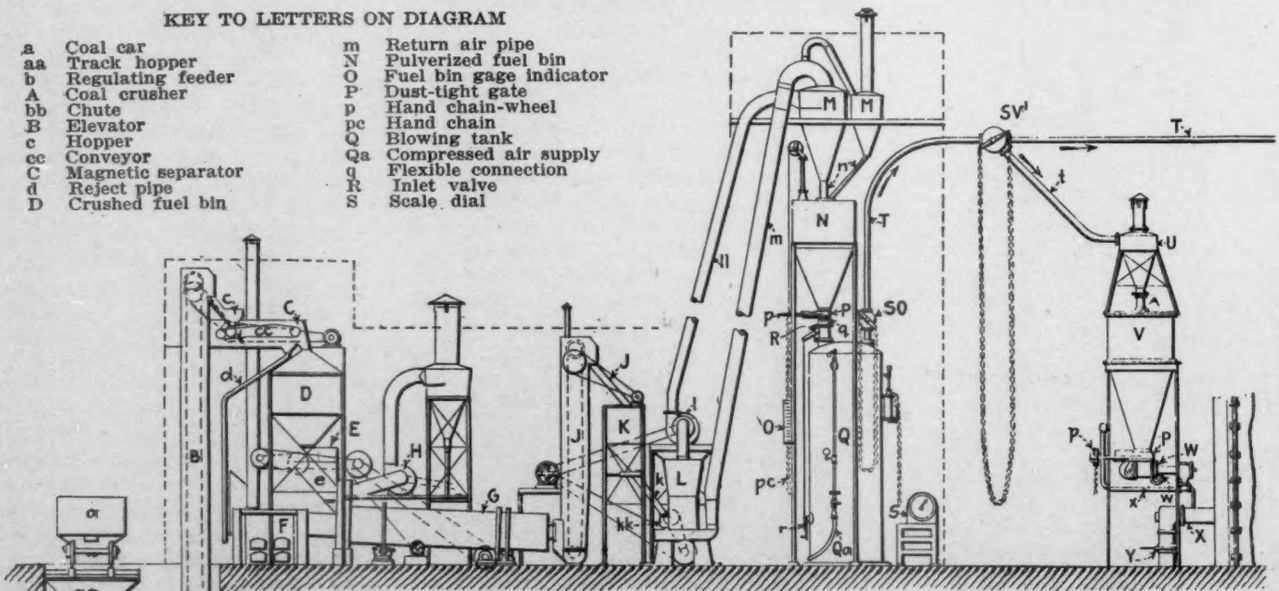


DIAGRAM SHOWING ELEMENTS OF POWDERED COAL MILLING PLANT AND AIR TRANSPORT SYSTEM

E	Regulating feeder	SO	Shut-off valve
e	Chute	SV	Switching valves
F	Drier furnace	T	Transport line
G	Drier	t	Branch fuel line
H	Exhauster	U	Collector
J	Elevator	V	Furnace bins
K	Dried coal bin	W	Fuel feed controller
kk	Rotary feeder	w	Fuel regulating wheel
L	Pulverizer	X	Burner
l	Exhauster	x	Primary air pipe to burner
ll	Discharge pipe	Y	Combustion air-blast gate
M	Collector		

The Technology of Air as a Power Medium

III, Windmills

The Energy of Air in Motion is used to generate Power—Essential Desiderata in the Construction and Operation of Windmills—Purely theoretical principles when applied to Wind Power Production are minimized by the complexity of the various factors involved.

By JACQUES S. NEGRU
Mining Engineer, New York

IN A PREVIOUS article (See COMPRESSED AIR MAGZINE, May, 1920, p. 9644) it has been stated that a very convenient classification of the different forms of air power and their industrial applications is the one based on the particular air property involved in the production of the power, and that the first class is based on the fluidity of the air.

Of all the applications of air power the oldest and the most widely encountered, although by far not the most important, are those based on the natural condition of the air in motion, namely of the wind.

Wind is nothing but a running stream of air resulting from variations in temperature or barometric pressure, or both, between adjoining air layers. Due to the inherent property of extreme fluidity of the air even small variations in these factors produce wind, which is thus ever present to a more or less marked degree.

Sailing vessels and wind mills are the two main groups of wind power applications. The former have been used almost since the beginning of historical times; as to the windmills written records mention their having been known and used in Asia during the 7th century, and there are official records of their having been used during the 11th century in continental Europe and in the British Isles.

This class of industrial air power applications, and particularly the windmills, is used even today to such an extent that it deserves a chapter in a description of Air Power Technology.

Wind Velocity

The velocity of the wind, i. e., the rapidity with which the air stream travels, is usually expressed in miles per hour, or feet per minute, or feet per second; in common parlance winds of different velocities are designated by well defined names. Fig. 13 shows graphically the values, miles per hour, expressed in feet per minute and feet per second. Table I gives the names corresponding to the different wind velocities.

TABLE I

Common Names for Different Wind Velocities

Wind Velocity Miles Per Hour	Names of Wind	Wind Velocity Miles Per Hour	Name of Wind
1	Barely observable	25	Very brisk
2	Just perceptible	30-35	High wind
3	Very light	40	Very high wind
4	Light breeze	45	Gale
5	Fair breeze	50	Storm
8	Fresh breeze	60	Great storm
10	Strong breeze	80	Hurricane
15	Brisk blow	90-100	Tornado
20	Stiff breeze		

THIS ARTICLE, the third in the series, on the subject of windmills, constitutes a chapter in the general subject of air power technology which deals with an important physical property,—fluidity. It is intended to cover in following articles, the property of expansibility, which is the principle of the hot air engine; elasticity, the principle of compressed air power; buoyancy, the property on which is founded the science of aeronautics, and finally, liquid air or change of state. The reader will note that the series presents a complete treatise on all phases of the use of air as a power medium, illustrating by various types of machinery, how the different properties of air have been adapted mechanically for the transmission of power.

The wind velocity is a function of the density of the air, and as the density varies with the temperature and barometric pressure it can be easily conceived that the intensity of the wind is bound to be very erratic even within narrow periods of time.

The velocity varies also with the height above the ground. There is no well defined ratio between these two factors, but it can be easily determined by the use of an anemometer. Experimental work for formulating such a ratio has conduced to discordant results. Thus, for example, some accept the relation $\frac{V}{v} = \sqrt{\frac{H}{h}}$, in which V and v are respectively the velocity corresponding to the height in feet above the ground H and h, whereas others consider the relation $\frac{V}{v} = \sqrt[4]{\frac{H}{h}}$ more concordant with actual facts. For practical purposes a convenient empirical formula is $V = v\sqrt{\frac{H+72}{122}}$, in which H is the height in feet above the ground, v the wind velocity at 50 feet above ground, and V, wind velocity at different heights above the ground. V is equal to v for H = 50 feet. Thus:

For H = 80 feet, $V = v\sqrt{\frac{100+72}{122}} = v\sqrt{1.41} = 1.19\ v$;

for H = 20 feet, $V = v\sqrt{\frac{20+72}{122}} = v\sqrt{0.75} = 0.87\ v$.

Types of Windmills

A windmill is a prime mover designed for utilizing the pressure of the wind as motive power. It consists essentially of a structure carrying a shaft at one end of which is fixed a specially constructed kind of wheel which is to be rotated by the action of the wind, the other end of the shaft being provided with mechanisms for the transmission of the movements of the wheel.

The windmills are classified according to whether the wheel rotates in a direction parallel to that of the wind or in a direction perpendicular to that of the wind and also according to whether the rotating shaft is vertical or horizontal.

Windmills in which the wheel rotates in a direction parallel to that of the wind are of very little practical use today. The same may be said about those in which the rotating shaft is vertical. The windmills which are the most commonly used at present are those in which the wheel rotates in a plane perpendicular, or nearly so, to the direction of the wind, the rotating shaft being horizontal, or nearly so. These mills are of two quite distinct types known as European mills and American mills.

European Windmills

The general construction of the European windmills is of two distinct forms. In the first the whole building which sustains the shaft, wheel and other accessories is supported upon a vertical post which can be revolved at will, when actuated upon by a lever. In the second only the upper part of the building, the dome, containing the shaft, wheel and accessories rest upon rollers and can be easily revolved by manual or mechanical contrivances.

The first form finds now very little practical application; the second also known as tower mills, or by the generic name of Dutch mill, is the most commonly used. The description of the European windmills will be therefore limited to that of the Dutch type of windmills.

Dutch Type of Windmills

These mills consist, as already mentioned, of a tower of varying heights—up to about 100 feet—of which only the upper part called the dome is movable. The dome carries a shaft placed usually at an angle of ten to fifteen degrees with the horizontal. To the protruding end of the shaft are attached four arms or whips of lengths varying from 30 to 40 feet on which are spread long sails covering about five-sixths of the total length of the whip. It is self-evident that for proper action of the mill the shaft should be parallel to the direction of the wind, but as the tower is conical in section, an angle of ten to fifteen degrees is necessary so as to permit the ends of the sails to clear the tower, and thus dis-

pense with the use of shafts of excessive lengths.

The sails are of canvas spread on a framework, or of narrow boards. They are plane, concave or warped and placed obliquely to the plane of rotation. The angle of the sail with the plane of the windwheel is called the angle of weather, or weather, and is usually about eighteen degrees at the inner end of the sail which is gradually decreased to about seven degrees at the outer end of the sail, the intermediate points forming angles between these two extremes.

The correct curvature of the sails has to be determined experimentally so as to most effectively change the direction of the wind into a direction as nearly as possible opposite to the direction of rotation of the wheel, and also that the receiving edge shall be tangent to the relative direction of the impinging wind.

The ratio between the width and length of the sail is about one to five. The sails occupy only a small portion of the area swept by them. The speed of the tips of the sails is about two and one-half to three times the velocity of the wind.

The inner end of the shaft is provided with a geared wheel which engages with a large toothed wheel, the teeth of which engage with those of a pinion upon a vertical shaft from which motion is imparted to the machinery using the generated wind power. The gearings are usually proportioned so that the number of revolutions per unit time of the vertical transmission shaft shall be about six times that of the wheel.

American Type of Windmills

The American mills differ from the Dutch mills by their having a wheel made up of a great number—eighteen or more—of narrow blades or slats arranged radially in rings or disks. The slats are of one piece or sectional and they may be fixed or movable, i. e., they form a constant or variable angle with the plane of rotation of the wheel. They present a larger surface to the wind than the Dutch mills for a given diameter of the area swept by the rotating wheel. The slats have a shape curved somewhat like a screw propeller, so that their surface makes an angle with the plane of the wheel which increases with the distance from the center. This angle, the weather, varies between 25 and 40 degrees depending upon the width of the sail and the diameter of the wheel. This diameter rarely exceeds 30 feet. For effectual wind action the slats, like the sails in the Dutch mills, are made and arranged so that the wind shall reach them tangentially and that they shall change the direction of the wind into a direction as nearly as possible opposite to the direction of rotation of the wheel. The speed of the wheel is about the same as the velocity of the wind.

Great ingenuity has been used by the American manufacturers of windmills to bring their mills to as near theoretically efficient performance as the variable factors involved would permit.

Without going into the details of the great variety in the assembly of the mills or in the accessories be it sufficient to mention that all the American windmills consist essentially of the following parts:

A windwheel with the shaft parallel to the direction of the wind which receives the kinetic energy imparted by the wind.

A steering wheel or rudder to bring the windwheel in a plane which is the most appropriate with the direction of the wind.

A speed regulating device to keep the windwheel within safe limits during excessive wind velocities.

Gearings for the transmission of the movements of the wheel to the machinery using the wind power generated.

A brake which holds the wheel stationary when out of the wind.

A main casting which supports the steering, speed regulating, gearing, brake and other applicances, and which constitutes the mill head.

A tower which supports the mill. The tower rarely exceeds 100 feet in height.

Steering Arrangements

The direction of the wind is a very erratic item. Its frequent and quite sudden changes demand an appropriate steering arrangement by which the relative position of the plane of rotation of the sails or wheels might be brought to form the best angle of impulse with the direction of the wind.

In the earlier days this was done by manual work, and one can easily picture the hardship and needed experience for the miller. Now it is very easily done by more or less efficient automatic contrivances. The principles of such automatic contrivances differ according to whether the sails or slats are movable or fixed.

In the case of movable or of sectional sails and slats, the angle of weather is automatically changed with a change in the direction of the wind so as to bring the plane of rotation quite perpendicular to the new direction of the wind. This is accomplished by flying out or receding weighted arms.

In the case of fixed sails or slats the automatic steering is realized mainly by the use of an auxiliary wheel, or by a rudder consisting of a large strong vane, placed in a plane at right angle with the plane of rotation of the main wheel.

When the direction of the wind changes so that it is not normal to the plane of rotation, the auxiliary wheel or rudder is acted upon by the wind with the result that the main wheel is steered to form the best angle of im-

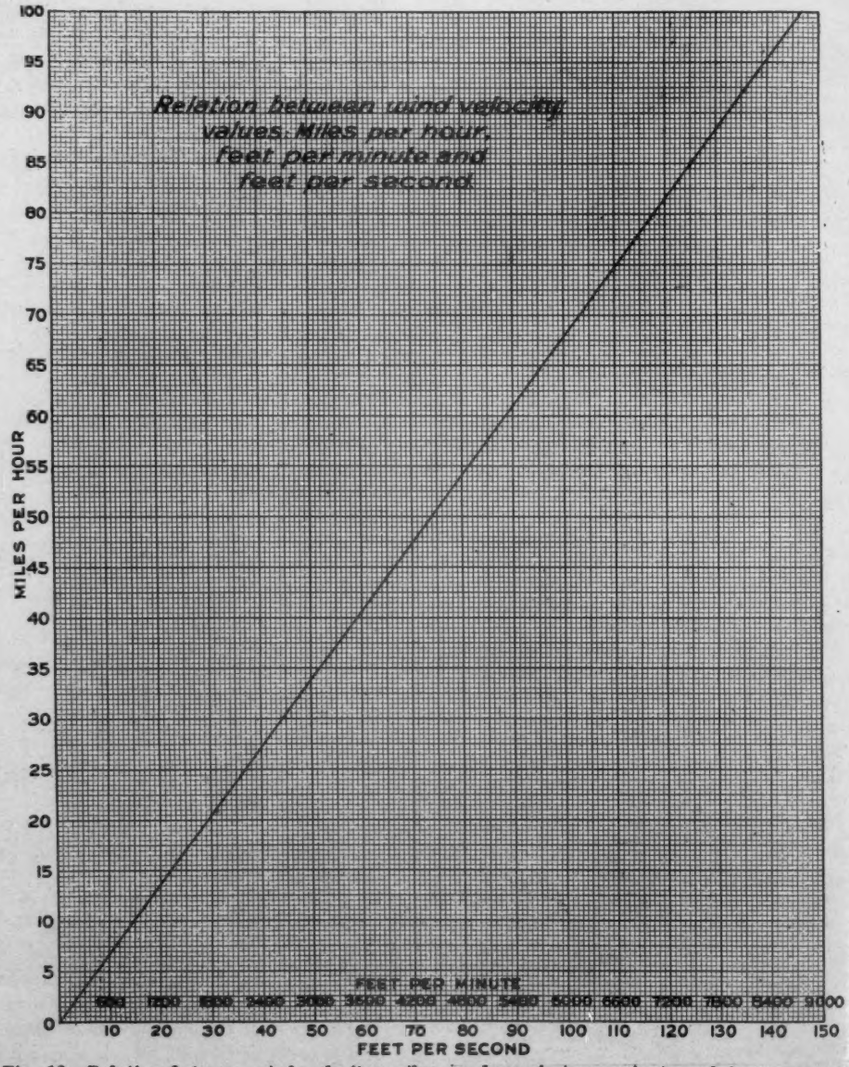


Fig. 13—Relation between wind velocity, miles per hour, feet per minute and feet per second

pulse with the wind. When the plane of rotation of the wheel is perpendicular to the direction of the wind the auxiliary wheel, or the rudder, is idle because it is then in a plane parallel to the direction of the wind.

The effort necessary for the steering is minimized by the use of roller bearings.

Speed Regulating Arrangements

The variations and wind velocity are often sudden and extreme, and if no arrangements were provided for regulating the speed of the wheel when the wind velocity exceeds the safety limits there would soon result the destruction of the mill.

The many forms of speed regulating contrivances may be grouped according to whether the sails or slats are sectional or solid.

When the sails or slats are sectional the following simple arrangements based upon the principle of reefing, i. e., varying the surface exposed to the wind, are quite efficient:

Use of sails or slats made of thin boards held up to the wind by weights. When the force of the wind exceeds a safe value, the boards are pressed backwards and thus the surface exposed to the wind is diminished.

Use of Venetian-shutter type of sails. The shutters are operated by a governor acting upon a rod passing through the center of the shaft and which opens or keeps closed the shutters according to the intensity of the wind.

In the case of canvas sails, the reefing is still done in some European mills by manual labor with ropes attached to each sail or section of sail. In modern mills the reefing is done automatically by the use of a centrifugal governor which consists of a sliding mechanism placed transversely with the whip. The unfurling of the reefed sails, when the wind velocity is again within safe limit, is accomplished by a weight which actuates a rod passing through the center of the main shaft and which operates centripetally in unfurling the canvas.

In American mills the reefing governors when the slats are solid consist mainly of a side blade located in the plane of rotation of the wheel. The movement of the blade is controlled by a weight. When the wind velocity exceeds a safe value the blade moves and brings the wheel to a position edgewise to the direction of the wind, thus diminishing the surface acted upon and keeping the speed of rotation within safe limits.

There are a great number of other speed regulating arrangements. Among them may be mentioned the use of friction straps applied to the outside of the wheel on the wind shaft.

The details of the various speed regulators, of which some are ingenious and quite complicated might better be studied by consulting the literature issued by windmill manufacturers.

Relation Between Velocity and Pressure Upon A Surface At Rest

The pressure exerted by the wind depends upon the wind velocity and the density of the air. The density depends upon the temperature, barometric pressure and pressure due to the air in motion. It is therefore necessary when formulating the wind pressure to take into consideration all these factors. The following calculations can be applied to the simple case of wind pressure upon a surface at rest:

V, velocity of the wind in feet per second.

p, barometric pressure of free air, in pounds per square foot.

p_1, barometric pressure of normal air, in pounds per square foot.

P, wind preassure in pounds per square foot

d_1, density of the air at pressure p_1 and absolute temperature T_1.

D, density of the air in motion at pressure $(p + P)$ and absolute temperature T.

g, velocity in feet per second (32.2) due to gravity.

Q. quantity of air in cubic feet carried along per second per sq. ft. of sectional area, equal to V cubic feet per second.

The density of the air in function of temperature, barometric pressure and pressure of the air in motion is given by the relation:

$$\frac{DT}{d_1 T_1} = \frac{p + P}{p_1}, \quad D = \frac{d_1 T_1 (p + P)}{P p_1} = \frac{d_1 T_1}{p_1} \times (p + P) = C (p + P)$$

The factors d_1, T_1, and p_1 are known, hence $C = \frac{d_1 T_1}{p_1}$ is known.

The pressure exerted by the wind in pounds per square foot in funtion of velocity and density is given by

$$P = \frac{D Q V}{2 g} = \frac{D V^2}{2 g}$$

By substituting the value of D,

$$P = \frac{C V^2 (p + P)}{2 g T}$$

$$2 g P T = C p V^2 + C P V^2; \quad P (T g - C V^2) = \tfrac{1}{2} \times C p V^2$$

$$P = \tfrac{1}{2} \times \frac{C p V^2}{T g - C V^2}$$

This is the theoretical wind pressure. For the value of the actual pressure the loss due to the friction of the particles of the air in motion must be taken into consideration. The value of P may then be written as

$$P = \tfrac{1}{2} f \frac{C p V^2}{T g - C V^2}$$

in which f may be taken for practical purposes to be equal to 0.9.

$$P = 0.45 \frac{C p V^2}{T g - C V^2}$$

Relation Between Velocity and Pressure Upon Windwheel

It has been shown above that it is quite elementary to calculate the relation between wind pressure and velocity when the wind impinges normally upon a surface at rest. For windmills in operation the wind velocity and pressure are factors contaminated with a series of not yet well formulated conditions, and, therefore, with all due consideration for the progress in the study of kinematics and dynamics, one would do better at present not to rely on theoretically formulated relations between the velocity of the wind and its pressure upon a surface in motion such as a windwheel, because they have to imply assumptions which are usually misleading. It is far more reliable in cases such as the one under consideration to use empirical formulas, which express the actual conditions of the best practical results.

An empirical formula for the relation between wind velocity, V, and its pressure, P, upon a windwheel, which is now amply satisfactory for practical purposes and which corresponds to the experimental results obtained at the Eifel Tower in Paris is

$$P = 0.003\ V^2$$

in which V is the wind velocity in miles per hour and P the pressure per square foot.

Fig. 14 showing the relation between velocity and pressure of the wind acting upon a windwheel is based upon this empirical formula.

Power of Windmills

What has been said about formulating the relation between the velocity of the wind and its pressure upon a windwheel applies the more so when it is attempted to formulate the power of a windmill, because the differences in the wind velocity and pressure in and about the windwheel, the friction between the air current and the various members of the wheel, the shape of the sails or slats, the angle of the plane of rotation of the wheel with the direction of the wind, eddies and other similar disturbing factors, all of which affect the final results, cannot be expressed in well defined formulas.

When considering the simplest case, namely, that the air current is brought to rest, the energy in foot-pounds per second which the wind would be capable to yield would be expressed by the well known relation, $\frac{W}{2 g} V^2$, in which W is the weight of air available per unit of time, V the velocity of the wind in feet per second, and g the velocity due to gravity (32.2). But in the case of a windmill this is complicated by the above mentioned factors.

The following theoretical calculation is given merely to illustrate the influence of the relation between the initial velocity and direction of the wind when it reaches the plane of rotation of the wheel and the velocity and direction of the wind when it leaves the wheel on the power and efficiency of the windmill.

Let A represent the mechanical component of the initial wind velocity and direction. The rotation of the wheel is due to the power derived from this component, therefore the value of A is decreased at the time it leaves the wheel. Let A_1 be the value of the resulting component of the final wind velocity and direction. Under the best conditions of wheel construction and operation, namely: that the receiving edge of the sail or slat shall be tangent to the relative direction of the impinging wind, that the direction of the wind is parallel to the surface of the sail or slat throughout the period of contact, that the velocity is constant throughout this period and that the resulting direction of the wind is as nearly as possible opposite to the direction of

rotation of the wheel, A_1 will be parallel to A and to the wheel shaft. If S designates the area swept by the rotating wheel and D the density of the air under the pressure (p + P) in which p is the pressure of the free air and P the pressure of the wind, the weight of the air reaching the wheel and of that which actually impinges upon the wheel per unit time are given respectively by

SAD and SA_1D, and the respective energies in foot-pounds per second are:

$$\frac{SAD}{2g} A^2 \text{ and } \frac{SA_1D}{2g} A_1^2, \text{ or}$$

$$\frac{SDA^3}{2g} \text{ and } \frac{SDA_1^3}{2g}.$$

The energy E in foot-pounds per second yielded by the wind to rotate the wheel is

$$E = \frac{SA_1D}{2g} A^2 - \frac{SA_1D}{2g} A_1^2 = \frac{SD}{2g} (A_1 A^2 - A_1^3)$$

The efficiency F, i. e., the ratio between the energy used and the energy supplied is

$$F = \frac{\frac{SD}{2g}(A_1 A^2 - A_1^3)}{\frac{SD}{2g} A^3} = \frac{A_1 A^2 - A_1^3}{A^3}$$

From this formula it is found that the maximum value of F is obtained when $A^2 = 3 A_1^2$; $A_1 = A \sqrt{1/3} = 0.578$ A, and by substituting

$$F_{max.} = \frac{0.578 A^3 - (0.578 A^3)}{A^3} = 0.387$$

i. e., the maximum efficiency which might be theoretically expected is 38.7 per cent.

The above assumed conditions for wheel construction and operation are not realized in actual practice. Besides the facts that the velocity and direction of the wind are in a practically continuous changing state there is also to be considered the fact that a large portion of the air passes through the interstices between the slats which not only does not produce power but instead absorbs some of the power produced by the acting portion of air. It is, therefore, more reasonable, when formulating the power of a windmill to accept the empirical formulas found by reliable experimenters from a series of practical tests.

For Dutch mills a quite reliable empirical formula for the horse power of the mills is

$$H.P. = \frac{S V^3}{1{,}080{,}000}$$

in which S is the total sail area in square feet and V the velocity in feet per second. Thus, for example, a windmill with four sails of 25 feet length and six feet width might furnish with a wind velocity of twenty feet per second

$$\frac{4 \times (25 \times 6) \times (20)^3}{1{,}080{,}000} = \text{about } 4.5 \text{ H. P.}$$

For American windmills the horse power which can be produced might conveniently and quite accurately be obtained by the use of a table of experimentally found results for a sixteen-foot diameter wheel under varying wind velocities and by the assumption that the windmill power is proportional to the square of the diameter of the windwheel. Thus for a sixteen-foot wheel

Velocity Miles Per Hour	Horse Power	Velocity Miles Per Hour	Horse Power
4	0.02	20	2.3
6	0.06	25	4.5
8	0.15	30	7.8
10	0.30	..	..
12	0.50	35	12.0
15	1.00	40	18.0

The horse power of a twelve-foot diameter wheel for a fifteen-mile per hour velocity, would be

$$1.00 \times \frac{\overline{12^2}}{16^2} = 0.56 \text{ H. P. and for a 20-mile per hour velocity,}$$

$$2.3 \times \frac{\overline{12^2}}{16^2} = 1.29 \text{ H. P.}$$

Transmission of Power

The transmission arrangement of the wind power is determined by the use to which it is to be put. Thus for pumping purposes the power is transmitted through a reciprocating rod. In a *direct stroke windmill* the pump rod makes one complete stroke for each revolution of the windwheel. The disadvantage of such arrangement is that when the velocity of the wheel exceeds a certain limit there occur shocks and violent churning of the water. In *back geared windmills* the pump rod makes only a fraction of a stroke for each revolution of the windwheel. This is the most commonly used transmission arrangement. The back gearing is calculated so as to reduce the pump speed to about 40 strokes per minute. For general power purposes such as grinding, sawing, cutting fodder, generating electricity, etc., the power is transmitted through a train of gears or pulleys and belts, to a vertical shaft. The ratio of speed reduction is usually 6:1, i. e., the vertical shaft makes six revolutions per revolution of the windwheel.

It might be expected that the ingenuity of windmill builders will lead to a more efficient and economic power transmission arrangement, of which the most promising is by the

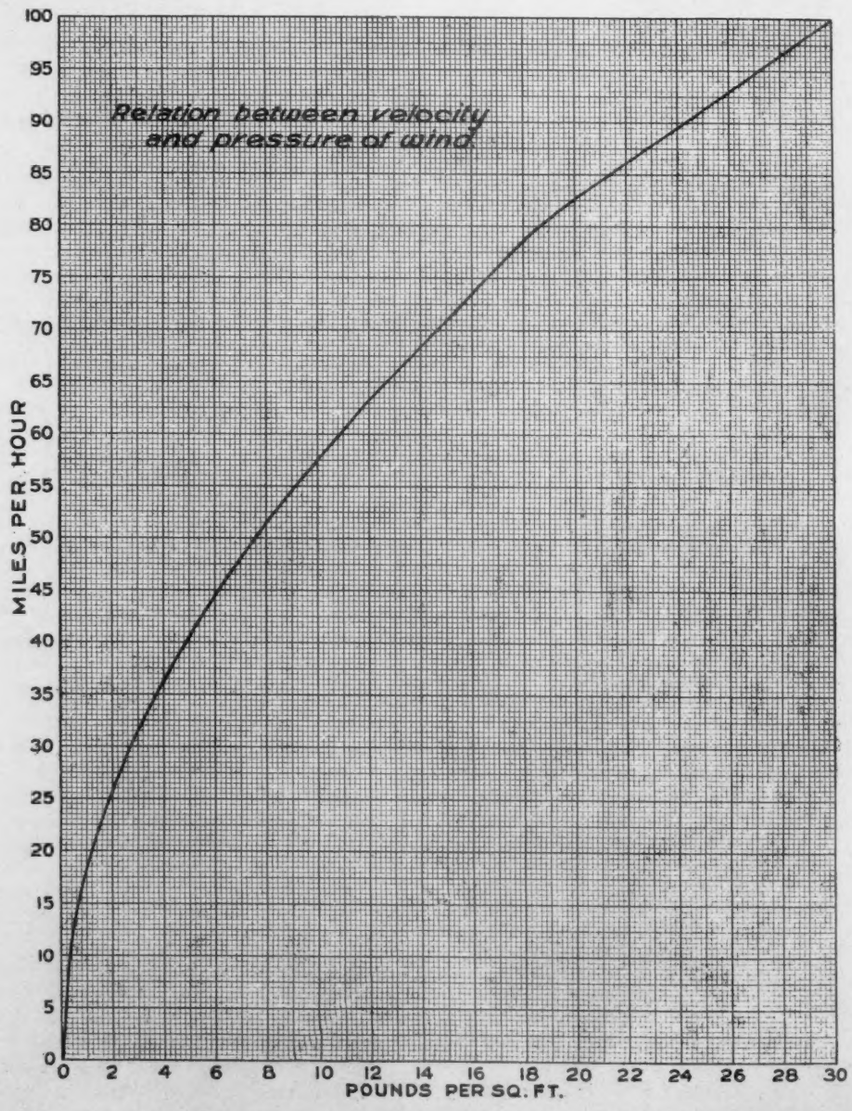


Fig. 14—Relation between velocity and pressure of wind. Acting upon a windmill

use of an electric generator direct connected to the windwheel shaft.

Factors in Construction of Windmill

It has been mentioned above that the very nature of the power producing medium involved (wind) makes that it is quite impossible to build windmills on mathematically calculated specifications.

With relatively very little deviation as to generalities the present day mills are still built on the basis of experimental deductions enunciated about 160 years ago by John Smeaton for Dutch mills and those enunciated about 40 years ago by Thomas O. Perry for American mills. Considering their importance in even the present day windmill industry they deserve to be reprinted here.

For Dutch Mills

The velocity of the windmill sails, whether unloaded or loaded so as to produce a maximum, is nearly as the velocity of the wind, their shape and position being the same.

The load at the maximum is nearly, but somewhat less than, as the square of the velocity of the wind, the shape and position of the sails being the same.

The effect of the same sails at a maximum are nearly, but somewhat less than, as the cube of the velocity of the wind.

The load of the same sails at the maximum is nearly as the squares, and their effects as the cubes of their number of turns in a given time.

When the sails are loaded so as to produce a maximum at a given velocity of the wind, and the velocity of the wind increases, the load remaining the same: first, the increase of effect when the increase of the velocity of the wind is small, will be nearly as the squares of those velocities; secondly, when the velocity of the wind is double, the effect will be nearly as 10 to 27.5; thirdly, when the velocities compared are more than double of that when the given load produces a maximum, the effects increase nearly in a simple ratio of the velocity of the wind.

If sails are of similar figure and position, the number of turns in a given time will be reciprocally as the radius or length of the sail.

The load at a maximum that sails of similar figure and position will overcome at a given distance from the center of motion will be as the cube of the radius.

The effects of sails of similar figure and position are as the squares of the radius.

The velocity of the extremity of the sails, as well as of enlarged sails, in all their usual positions, when unloaded or loaded to a maximum, is considerably quicker than the velocity of the wind.

For American Mills

The maximum power from a given windmill varies directly as the cube of the wind velocity.

The speed of the windwheel, when developing its maximum power varies directly as the wind velocity.

The speed of the windwheel when unloaded is somewhat greater than the velocity of the wind.

The most efficient windwheel speed, when loaded, is about 55 per cent. of the speed of the wheel when unloaded.

The load upon a windwheel when developing its maximum power varies directly as the square of the wind velocity.

The capacity of a windwheel varies directly as the square of the diameter of the wheel.

There is nothing gained by having the slat area of a windwheel greater than seven-eighths of the area swept by the wheel, and there is little gained by having it more than three-quarters of this area.

The slat surface should extend only over two-thirds of the radius from the outer diameter to the center.

A conical deflector at the center of the wheel does not improve on the power of the mill.

A deflector in front of the wheel increases the speed of slow moving wheels, but has no effect on fast moving wheels.

Obstructions on the back of the slats greatly reduce the power of the mill. The back of the slats should be smooth.

Wide slats are better than narrow slats.

It is better to divide a given sail surface between a few sails than to have a large number.

The supporting mast offers more obstruction when in front of the wheel than when behind it.

There shall be the least possible obstruction behind the wheel.

There is a limit to the size of the wheel. For equal safety in storms, the weights of windwheels of different sizes and like forms should be proportioned as the cube of their diameter.

There has been no improvement on these deductions. The recent improvements in windmill construction and operation are limited mainly to mechanical details for steering, speed regulating, transmission of the power generated, and during the last few years to generating electricity by wind power.

Applications of Wind Power

It is not essential here to go into the details on the varied uses to which wind power may be applied. Be it sufficient to state that it is best adapted to where intermittent power is usually required, and also when the power required is quite feeble, because the average number of hours per day when the wind is of sufficient magnitude to generate power is about eight and the actual useful power developed under favorable conditions by an average size mill seldom exceeds one horse power.

Wind power is mainly applied to pumping water. It is also used in a great variety of odd jobs such as: sawing, grinding, cutting fodder and the like.

The main trend now in taxing the ingenuity of windmill manufacturers is to devise actually economic and efficient appliances by which the wind power shall be transformed into the very handy electric power. During the last few years there has been published quite a number of enthusiastic reports about the solution of the problem of cheap and steady wind generated electric power. The problem is not yet solved satisfactorily, but it is bound to be solved because the great and world-wide importance of such a solution is realized by all interested in the subject.

The Selection of Windmills

The first requisites in the selection of a windmill must be a preliminary study of the local weather conditions to determine the factors of wind velocity and direction, to estimate the average number of hours per day during which it might reasonably be expected that the intensity of the wind is within appropriate limits and to obtain some information about the probabilities of occurrence of abnormal meteorologic conditions (which are usually based on past known occurrences). A systematic use of the wealth of information published by the U. S. Weather Bureau will generally furnish the above desiderata.

The next point to be considered is the nature of the work to be performed by wind power.

Only when the conclusions derived from such study warrant the erection of a windmill will it be logical to consider the characteristics of the mill to be selected.

The principal characteristics to be considered are:

Stability of the tower and the cost of its foundation.

Efficiency of steering and speed regulating devices.

Ease of erection and operation.

Size of wind engine relative to the power generated.

Cost.

Advantages of the American Windmills and Prospects for Installation

At present windmills are commonly used in localities where there is no other cheap mechanical power available, such as on newly opened or isolated farms. This does not imply that windmills might not be useful even where artificial power is available and quite cheap. There are places where the local weather conditions and the kinds of work to be performed do warrant the installation of windmills with good expectations of a cheap and relatively efficient power.

It is a costly mistake to consider that windmills installed at different places will generate an equal amount of power even when the make and size of the mill are the same for similar work to be performed and the upkeep quite as careful, because the local weather conditions are the main determining factors in windmill performance.

The American type of windmills might not possess the poetical inspiring power of a Dutch mill, but they are just as well at home in back yards of thickly populated cities as along some romantic paths bordering canals or brooks or in open fields. Their form and method of operation give them a wider range of utility, and this is best proved by the ever increasing number of mills installed and by their actually replacing the Dutch windmills even in the Dutch populated countries.

Table II, taken from the April 14, 1920, issue of *Commerce Reports* published by the U. S. Bureau of Commerce shows that during the calender year 1919, there has been exported windmills to the value of $1,091,543.

TABLE II. EXPORT OF WINDMILLS FROM THE UNITED STATES DURING THE CALENDAR YEAR 1919

Destination	Value
Belgium	$838
Denmark	5,419
France	10,357
Greece	4,539
Iceland and Faroe Islands	203
Italy	13,947
Malta, Gozo, and Cyprus Islands	62
Portugal	1,446
Spain	3,949
England	28,427
Scotland	974
Ireland	50
British Honduras	131
Canada	79,381
Costa Rica	117
Guatemala	806
Honduras	230
Nicaragua	552
Panama	241
Salvador	393
Mexico	40,724
Barbados	690
Jamaica	789
Other British West Indies	588
Cuba	56,263
Danish West Indies	2,112
Dutch West Indies	6,324
Dominican Republic	4,361
Argentina	376,383
Bolivia	63
Brazil	30,943
Chile	8,361
Colombia	101
Paraguay	3,508
Peru	9,284
Uruguay	23,675
Venezuela	2,526
China	591
British India	385
Straits Settlements	465
Other British East Indies	59
Japan	1,115
Turkey in Asia	2,346
Australia	30,775
New Zealand	8,910
French Oceania	80
Philippine Islands	94
British West Africa	2,981
British South Africa	302,609
British East Africa	370
Canary Islands	1,545
French Africa	6,111
Morocco	8,973
Portuguese Africa	4,965
Egypt	412
Total	$1,091,543

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In addition to the above, valuable information is to be found in the literature published by the manufacturers of windmills and wind power appliances, and in patent specifications.

It is announced from Victoria, B. C., that four airplanes are to be used this summer in carrying ore from mines of the Granby Mining Company twelve miles to tidewater at Stewart, B. C. Each plane will carry 1,000 pounds of ore every trip. Freight charges, it is estimated, will be reduced to 50 per cent by air plane transportation.

Michigan is the leading state in the manufacture of sand-lime brick, followed by Minnesota and New York.

COMPRESSED AIR STIRS UP ENGINEERS DINNER

THE SECOND Anniversary dinner of the Engineers' Club of Dayton was held in the new club building in Dayton recently and among the many entertaining features on the programme the most surprising and appropriate were various adaptations of compressed air to provide amusement for the guests.

In the course of the dinner a considerable commotion was caused by the sound of escaping compressed air which some of the members had ingeniously piped beneath the tables so as to raise the table cloths in the form of a balloon. This occurred at frequent intervals in various places at the different tables.

Later in the course of the dinner and while one of the speakers was delivering an entertaining address a beautiful large innocent looking fern situated in the middle of the center table showed considerable activity and ambition by suddenly converting itself into a fountain. A small stream of water was seen to arise from the foliage in the fern dish which no doubt started with goodly intent, but wound up by spraying the speaker at the head of the table with deadly accuracy. After this the said fern became quite unruly and squirted tiny streams intermittently to all parts of the room. Various other entertaining features were added which caused considerable merriment.

The most pleasant and interesting part of the evening's entertainment was the speeches following the dinner. The speakers were introduced by George B. Smith, chairman. The speakers of the evening were: J. E. Barlow, City Manager of Dayton, Ohio, whose theme was "Community Service." Mr. Barlow laid particular stress on the importance of the individual engineers as well as the Engineering Societies' interests in their local city and community government, stating and setting forth very clearly the fact that the managing of a city or community government was largely an engineering proposition. His speech was enthusiastically received and all present were very much impressed with the truthfulness of his arguments.

The next speech, "The Engineer and His Country" was delivered by Arthur E. Morgan, Chief Engineer of Conservation. Mr. Morgan said that engineers in general should adopt some engineering subjects as a hobby entirely different and aside from his regular daily occupation, and that they should devote as much time to said hobby as possible so as to become an expert on same.

He further stated that discussions on engineering problems affecting Public Improvement, etc., are too often based on generalities and that there are too few individuals sufficiently informed so as to be able to state exact facts conclusively.

The third speaker was C. F. Kettering, of the Delco Company, who spoke on "A Citizen of the World." Mr. Kettering had just returned from abroad where he spent some time in the investigation of business conditions in general and his remarks were replete with interesting features. He dealt strongly on economics of business as applied to the world situation to-day and his various anecdotes on experiences he had in connection with large manufacturers in France and England were of interest.

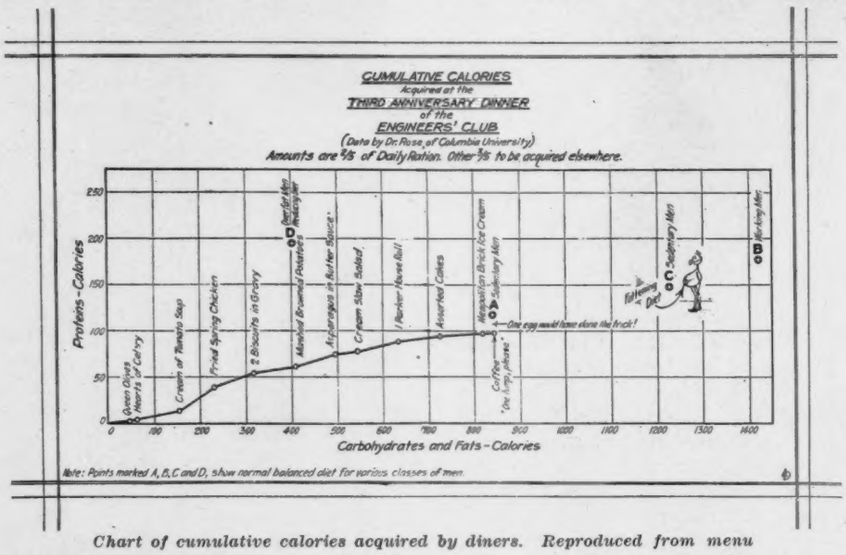
CUMULATIVE CALORIES
Acquired at the
THIRD ANNIVERSARY DINNER
of the
ENGINEERS' CLUB
(Data by Dr. Rose, of Columbia University)
Amounts are ⅔ of Daily Ration. Other ⅓ to be acquired elsewhere.
Proteins - Calories
Carbohydrates and Fats - Calories
Note: Points marked A, B, C and D, show normal balanced diet for various classes of men.

Chart of cumulative calories acquired by diners. Reproduced from menu

The last speaker was E. L. McColgin of the Dayton Chamber of Commerce. His subject was, "A Citizen and the Chamber of Commerce." Mr. McColgin described the relationship between the citizen and the Chamber of Commerce. There is no doubt but that all who were present will agree with Mr. McColgin that each and every citizen of a progressive city owes much to its chamber of commerce and should lend a helping hand at all times.

One of the features in connection with the evening was the providing of each member and guest with a tag to be attached to the coat lapel. Said tag had a place for name of party and "Job," together with a space for pasting on a cut of the type of machinery or line of business each individual was interested or engaged in. This eliminated the necessity of introductions and greatly assisted all in becoming acquainted.

Novel Uses for Compressed Air at Railroad Shops

By C. W. GEIGER

COMPRESSED AIR is being used for a number of purposes at the railroad shops maintained by the California State Board of Harbor Commission, at San Francisco.

The installation includes an 8x6 air compressor operated by a 10-h. p. electric motor. Until recently there was a compressed air tank 36 inches in diameter and 6 feet in height, installed on the outside of the shop, but the numerous uses to which compressed air is being put, necessitated the installation of an additional tank. This tank is 44 inches in diameter and 14 feet in height. Both tanks are mounted on heavy timbers 12 inches square. These two tanks are connected in such a manner that either can be used independently of the other. If it is desired to run up a high pressure quickly, the large tank is shut off. The method employed in operating the valve between these two tanks, is illustrated in figure 1. This valve is placed at the top of the 14-ft. tank, and is connected to a rod which extends to a point within the shop, within easy reach of the air compressor, enabling the valve to be operated from the inside, thus eliminating the necessity of climbing a ladder. This valve is shown by the arrow.

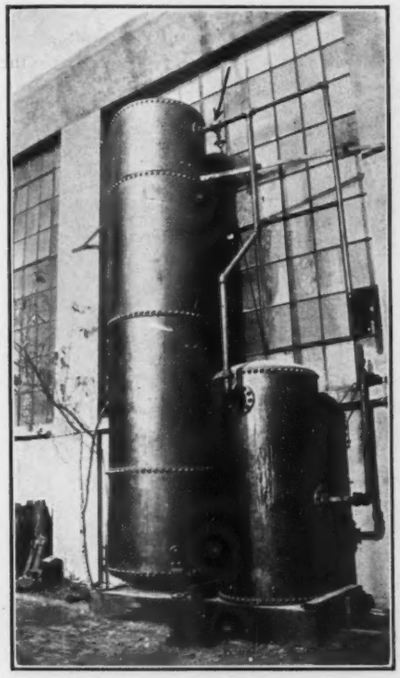

Figure 1—Valve at top of tank operated by rod extending inside of shop

Air is carried at a pressure of 90 lbs. to the square inch, but by means of reducing valves it is reduced to 45 lbs. for the sand delivering device, and to 70 lbs. for the oil delivering device, which will be described later.

In the shop, air motors are used for operating the valve setting machine. There is also a close quarter air drill, two standard air motors, one turbine for high speed work, and a portable grinder.

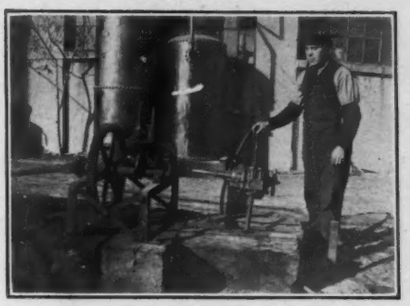

Figure 2—Method of attaching air drill to driving apparatus for flue cleaning machine

The foreman of the shop has constructed a flue cleaning machine, which is operated by the standard air motors. This machine is situated within a few feet of the air tanks. An air hose connection is provided at the large tank, to which can be connected the air hose leading to the air drill. The method of attaching the air drill to the driving apparatus is shown in figure 2.

The flue cleaning machine is shown in figure 3. Special sockets are provided for operating the driving mechanism. Provision has been made for supporting the air motor while it is driving the machine, so that it is not necessary to give it any attention after it has once been placed in operation. The driving mechanism is provided with a clutch for driving the flue cleaner forward or for reversing. This equipment does the work of seven men, about 100 flues can be cleaned by one man in an hour.

A large air motor is used in driving the flue cleaner when it is desired to run the cleaner at a slow speed, but when it is desired to run at a higher speed, a smaller air motor is used.

The success attained in delivering sand to the state locomotives by compressed air, resulted in the engineer of the Harbor Board designing a system for delivering fuel oil to the locomotives by compressed air. Ordinarily the fuel oil is delivered by an electrically operated oil pump, the compressed air being used only in emergency in case the current should be shut off or in the event it becomes

Figure 4—Arrangement for delivering fuel oil to locomotives by compressed air

Figure 3—Flue cleaning machine. One man can clean about 100 flues in an hour which formerly required seven men.

necessary to make repairs on the pump or motor.

By referring to figure 4 the operation of the compressed air equipment can be readily understood.

The fuel oil is stored in a subterranean oil storage concrete tank, under the concrete building shown to the right in figure 4. A small steel tank 44 inches in diameter and fourteen feet in length is placed under the ground at a level below the bottom of the main fuel oil tank. This small tank is placed in a concrete pit, with a removable top, which gives easy access to the tank in the event it is necessary to make repairs. The arrangement is shown in figure 5. The small tank is connected with the main storage tank by a pipe at A, a valve D, is placed along this pipe line, and a rod extends to the surface of the ground with a hand wheel E. By operating this wheel the valve D can be opened, which permits oil to flow by gravity into the small tank. When the small tank is full, valve D is closed. A valve in the compressed air line is then opened which permits the air pressure from the two air tanks to enter the small

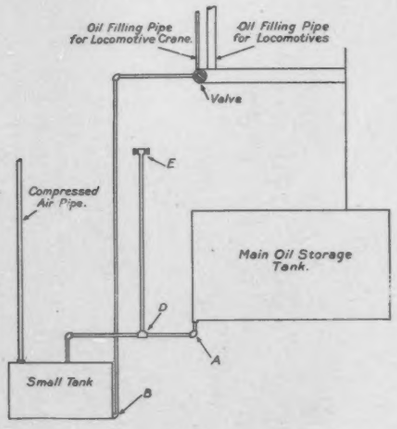

Figure 5—Plan showing tanks, valves and pipe line for delivering fuel oil to locomotives by compressed air.

tank at the top. A delivery pipe extends from the small tank at B upward to the oil loading pipes, through which the oil is forced out by the compressed air into the tank of the locomotive. This pipe and the oil loading apparatus are shown in figure 4. There are two oil loading devices, one for the locomotives, and the other for the locomotive cranes, of which the state has recently bought two.

A valve with a handle for convenient operation is placed on the main line overhead at the oil filling pipes. When this valve is closed the oil is delivered through the smaller oil filling device to the cranes, and when it is opened and the valve on the outer end of the small oil filling device is closed, the oil will be delivered through the oil filling device for the locomotives. Oil can be delivered by compressed air through the larger filling device, to locomotives at the rate of 1700 gallons in seven minutes, which is about the capacity of the small oil tank. Oil can be delivered through the smaller filling device to the locomotive cranes, at the rate of 144 gallons in two minutes.

After the oil has all been forced out of the small oil tank, the operator opens a valve in the air line, releasing the air pressure in the small oil tank, so that it may be filled again. This air valve can be seen in figure 4 near the bottom of the oil pipe as shown by the man's hand.

Personal Intelligence

Harry J. Wolf announces that he has resumed general practice as mining engineer with offices at No. 42, Broadway, New York.

* * *

William Plumb has been appointed superintendent of the Centennial-Eureka Mine, Eureka, Utah. This property is owned by United States Smelting, Refining & Mining Company. Mr. Plumb was previously chief assistant to R. E. Hanley, superintendent of the Mammoth Mining Company of Maine, Kennett, California, a property also owned by the United States Smelting, Refining & Mining Company.

* * *

Charles F. Overly has recently been appointed general manager of sales, of The Structural Tool Co. of Cleveland, Ohio, one of the Sixth City's newest large industries. For years Mr. Overly was connected with the manufacture of pneumatic tools, after which he formed The Overly Industrial Tool Co., becoming president of same. Upon the formation of The Structural Tool Co., Mr. Overly was induced to combine forces with the new corporation. The company is located in its new plant on West 106th Street, Cleveland, where it manufactures rivet sets, chisel blanks, punches, dies and pneumatic tool parts.

* * *

Henry Russel, of Detroit, vice-president and general counsel of the Michigan Central Railroad, died of pneumonia recently, aged 67 years in New York. Mr. Russel was senior member of the law firm of Russel, Campbell, Bulkley & Ledyard, president of the Detriot Manufacturers' Railroad and the Cass Farm Company, and director of several local banks and industrial corporations. He belonged to the University and Transportation Clubs of New York.

* * *

Hennen Jennings, noted mining engineer, died of heart disease at his home in Washington, D. C., this spring. He was born at Hawesville, Ky., in 1854. After graduation in civil engineering from the Lawrence Scientific School, Harvard University, he went West as an accountant in a California mine. He became interested in mining engineering, and quickly gained a position of eminence in that profession as the result of extensive experience in the United States, Venezuela and South Africa. He was the first president of the South African Association of Engineers and Architects. During the Pan-American Scientific Congress he was chairman of the sections of mining, metallurgy, economic geology and applied chemistry, and during the war he was attached to the Bureau of Mines as voluntary consulting engineer.

A. T. Shurick, mining engineer, and until recently identified in an editorial capacity with *Coal Age* and other national coal trade journals, has become associated with F. C. Thornley & Co., Inc., construction and consulting engineers, 31 West 43rd Street, New York, and will serve in the position of vice president of the company.

* * *

Charles Dougherty of the Ingersoll-Rand Co., New York, was taken ill with appendicitis while attending the railroad convention at Chicago. Mr. Dougherty's condition showed rapid improvement after an operation and he recovered completely after several weeks' illness.

* * *

Francis E. McGovern, of the law firm of McGovern, Harman, Reiss and Devos, of Milwaukee, Wis., has been appointed general counsel of the U. S. Shipping Board Emergency Fleet Corporation, and placed in general charge of the settlement of construction claims, as chairman of the Construction Claims Board, and has assumed his duties at Washington. Mr. McGovern is a graduate of the University of Wisconsin. He has been actively engaged in the practice of law for many years at Milwaukee. When the World War began he was commissioned first as Major and later as Lieut.-Colonel in the Judge Advocate General's Department, and had charge of some of its most important work.

* * *

Dr. William H. Maxwell, Superintendent Emeritus of the Board of Education of New York City, died in May, leaving behind him a record of hard and fruitful work on behalf of the world's greatest educational institution. The public school system of New York has on its rolls the names of 837,000 pupils in elementary and high schools. Instruction is carried on in 530 buildings, many of them of immense size, some distinguished for their modernity, architectural beauty and engineering completeness. Instruction is given by 21,000 teachers. The budget appropriation for this year's maintenance of the schooling system is $49,408,582. These figures give some idea of the extent of the department with which Dr. Maxwell's reputation has been associated.

* * *

George Ziegler, Secretary of the Philadelphia & Reading Railway Company and Vice President of the Reading Company, died from heart disease at his country home near New Hope, Pa. Mr. Ziegler was 63 years old.

* * *

At the annual meeting of the Chamber of Commerce of the United States held at Atlantic City, Jose H. Defrees of Chicago, was elected president to succeed Homer L. Ferguson of Newport News, Va., who retired after a one-year term. The following board of directors for the next year was elected:

Bernard J. Rothwell, Boston; Ernest T. Trigg, Philadelphia; John M. Crawford, Parkersburg, W. Va.; M. J. Sanders, New Orleans; John L. Powell, Wichita, Kan.; Edwin Clark Gibbs, Cincinnati; William J. Dean, St. Paul; Clyde C. Dawson, Denver; Nathan Straus, Portland, Ore.

Using Air Agitation in Ice Manufacture

The Raw Water Plant Makes a Purer Product than the Distilled Water Type—Expect the Former to become the Standard Method in Future

By A. H. HUTCHINSON*

IF I WERE in the market to purchase an ice plant, it would depend solely upon the water to be used as to whether it would be a raw water plant or a distilled water plant, and I should say that in 99 cases out of 100, this would mean a raw water plant.

There are few waters that cannot be treated so as to make raw water ice as good or possibly better than distilled water ice. So far as I know, this is the case in any city where there is a distilled water ice plant and also a raw water ice plant in which both plants use the same kind of water.

There are two kinds of raw water ice plants on the market; first, the plate plant; second, the can system.

The plate plant is the oldest, but we will not discuss it on account of the first cost of machinery, buildings, etc.

The can system is divided into two distinct types: first, the removable can type which was patented about twenty years ago and has undergone a good many changes since it was first introduced. The second or stationary can type which was originated considerably later than the other type has also undergone many changes.

Necessity of Air Agitation

It has been found that in order to make clear raw water ice of a reasonable water, all that is necessary is to properly agitate this water during the freezing process, and it has also been found that where the air agitation ceases the ice freezes white.

In the removable can type there are two forms of introducing air to the water. The first and oldest type is by means of a small tube fastened to the can. Sometimes this tube is inside of the can and sometimes outside. The other type is what is known as the drop pipe, which is a brass tube ¼ to ⅝ in. in diameter dropped into the can at any convenient point, either along the side, along the end, or, if preferred, in the center. It has been found that it is immaterial where the air is introduced, provided the air has been thoroughly dried, or in other words, all of its moisture removed. Dry air will not freeze, and the only thing that makes these frozen tubes is the introduction of air still containing moisture.

In the above type, that is, where the tube is fastened to the can or where it is dropped into the can, it is necessary to carry your pressure from 10 to 25 lbs. and at this pressure it has been found that with dry air it will continue to blow even after the ice is frozen, because, as before stated, dry air will not freeze, so that with this system if the tubes do not freeze owing to the moisture in the air, they will continue to blow and consequently will give a perfectly clear block of ice all the way through with the exception of possibly a little bit of fetter at the bottom of the air tube and a small streak of white showing the location of the air tube.

THE ECONOMICAL manufacture of artificial ice is of vital importance to mankind, and in all probability the number and size of plants in use throughout the world will multiply many times in the next decade. As conditions gradually return to normal, the matter of cost of the production of ice will receive more and more consideration, and the method that is reliable and insures minimum cost is the one that will survive.

Without doubt the present tendency is to use the raw water system, and the vast majority of such plants now being installed use duplicate units of single stage, horizontal, double-acting, 30 to 40 pound pressure air compressors operated by electric motors for agitation. One machine to carry the load and the other for a standby.

In selecting the compressors as well as all of the apparatus, first cost should be of secondary consideration, for it is necessary that the machinery should have a long life, be easy to take care of, and be thoroughly reliable and dependable.

In the stationary can type the air is introduced in the bottom of the can, and at a certain point of the freezing process it is shut off, consequently there is a certain amount of white core. This white core depends considerably on the kind of water that is used, that is, whether it has much foreign substance in it that will cause a white core. If there is not much of this matter in the water, the core will not be as bad as the average distilled water ice, providing the freezing process is carried on in such a way that the ice freezes perpendicularly and practically closes at one time through the entire length of the block. If, however, the freezing process is not carried on so that the ice is frozen perpendicularly it closes up at some point quicker than another with the results that a larger and whiter core is formed.

The cost of harvesting raw water ice on either of these systems is less than on the distilled water type, largely on account of the fact that in a distilled water plant it is usually calculated so that a greater quantity of water per minute is delivered for freezing process, while on the raw water plant there is a constant supply of water, and consequently it is not necessary to regulate the pulling time as closely.

Ice from Raw Water Plants

Raw water plants will make ice as pure or purer than the water from which it is made, consequently if the water used in making the ice is water that is being used for domestic purposes, it is in every instance sufficiently pure for ice making purposes, although it may be necessary to treat this water in order to remove lime, magnesia, or coloring matter, in order to make the block clear. There is nothing in the agitation of the water which will remove disease germs, but a certain amount

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Ice making in New Jersey. Where big blocks are frozen

*Abstract of a paper presented before the Southern Ice Exchange, Anniston, Ala.

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Pulling in big blocks. Owing to the uncertainty of this supply the artificial ice plant is essential.

of foreign matter is thrown off from the water by means of the freezing process and gathers on the surface of the ice as it freezes. This agitation of the water during the freezing process washes off these impurities and they are carried to the center of the can, so that in the process as above described, it is necessary to remove the core water, providing there is so much foreign matter in the water as to produce a white or objectionable core.

Impurities in Condensed Steam from Boilers

We all know that the water used in manufacturing distilled water ice comes from the boiler in the form of steam and this steam in turn is used for operating the various machines. These machines operated with steam will require a certain amount of lubrication, and regardless of how careful the engineer may be, there will occasionally be some of this oily matter appearing in the ice, so that as first remarked, there are very few places where the raw water plant cannot be installed and produce as good or better ice than distilled water.

Both types of raw water ice making, that is, the stationary can and removable can, have certain points of advantage one over the other, and it is an easy matter for you to determine this for yourselves by interviewing any of the representatives of the various ice machine manufacturers handling raw water machinery.

Personally, I do not know of many distilled water plants that are being installed at this time, whereas, I do know of a great number of raw water plants that are being installed even as small as six tons. I also know of several distilled water plants which are being changed to raw water type, and I believe that one of the reasons for this is due to labor conditions as well as better ice. We all know that labor conditions for the last two or three years have been very serious. It has been almost impossible to get men to stay on the tank for twelve hours on a stretch as has been customary on distilled water plants, in order, as I stated before, to have water for filling cans. It is not so difficult to get a can puller to work six or eight hours, and when the raw water plant is properly installed there is no difficulty in pulling the necessary amount of ice to make capacity with two shifts of six or eight hours each.

Raw Water Plant in General Favor

On the whole, the raw water plant is most surely the plant of the future, and those of us who have distilled water plants should, I believe, spend some time and money in personally investigating the situation.

As it is evident that the raw water plants are in most general favor and are the ones that are being largely installed today, the next question to decide is whether to install electric or steam drive.

We are all aware of the fact that the price of labor and coal today is abnormal and I believe that we all realize that sooner or later the question of labor and coal will seek a lower level, but I do not believe it will ever get back to what it was some four or five years ago.

The question, so it seems to me, would be the cost of the production rather than anything else, and I would therefore advise the system which would produce the ice the cheaper; by that I mean take into consideration the question of how many dollars per year will it cost to turn out 100 tons of ice, or any other given quantity. Don't rely on how many tons of coal or how many kilowatts will be required to turn out a ton of ice because that example is based on the best conditions, whereas, there is the winter months to contend with which in the North makes it easy, but in our sunny South it adds to the cost per ton so that the only safe way is to take your yearly output as against your yearly cost.

At the present time, I am of the opinion that there are steam plants producing ice at less cost than is produced by electric plants; while I also know of electric plants which are producing ice at less cost than steam plants.

Most steam plants of today are of the

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Storing ice at Wellesley Plant of Boston Ice Co. After washing, the ice is stored in this building which, after it is filled is sealed and kept closed until needed in the summer.

standard horizontal return tubular type of boiler using simple Corliss engines.

To produce power cheaply our boiler plant should produce the greatest number of pounds of steam per pound of coal, and our power plant or engine should produce the greatest horsepower for the least possible pounds of steam, and with such a plant steam is hard to beat even at present prices of coal and labor, and as I before remarked, I am of the opinion that coal and labor will be cheaper but there is a question in my mind as to which way electricity will go, up or down.

There is no doubt but that an electric driven plant is in a way an ideal one and the first cost is much lower, yet I am of the opinion that the economical steam plant will give a lower cost per ton in some cases.

One advantage of the electric drive is saving of space and building and in larger cities where plants are put right down in the center of the town, the electric drive on anything like equal terms is the only thing to use. Many purchasers want to know, and naturally so, "how much ice will your machine make per ton of coal?"

If you will stop to think that in a steam driven plant it is largely a question of boiler. A boiler plant evaporating ten pounds of water per pound of coal will produce more ice per ton of coal than the boiler plant which evaporates but six pounds of water per pound of coal. Each case should be carefully considered, because I do not believe that there is any fixed rule which would determine the best power to use, excepting in a case of the distilled water plant using simple engines and the six pound type of boiler.

On the other hand, in the use of electricity there are certain types of motors and certain methods of operating the machinery by these motors that reduce the cost of operation, and it would be my opinion that in deciding on either steam or electricity, the purchaser should when possible consider both the most economical steam plant and the most economical electric plant.

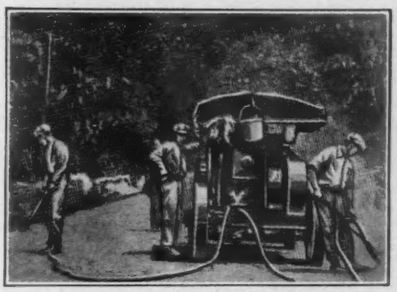
Before closing, I want to state that it has been my privilege and pleasure to watch certain experiments which have been carried on for the last three or four years in reference to the manufacture of raw water ice, and I believe that I am safe in stating that the inventor of this system has discovered something that will be of great value to the ice manufacturer, because if I am not much mistaken he has a system which will be able to take any kind of water and make crystal clear ice from it.

I am also of the opinion that with this plant there will not be the present losses due to the lack of insulation, and I am also of the opinion that a still further gain can be made in time of harvesting the ice.

It is too bad that this experiment has not gone sufficiently far to allow me to enter into detail, but from past experience and observation, I believe that I can truthfully state that unless some unforeseen difficulty arises in structural detail it will be the coming ice plant of the future.

USING COMPRESSED AIR TO CLEAN ROADWAY

The highway engineers for the Palisades Interstate Park on the Hudson River, near West Point, New York, used modern methods in making the main park drive as clean as possible before they placed a new wearing coat on it according to George F. Paul in *Better Roads & Streets.* This roadway extends back twelve miles from Bear Mountain, on the Hudson River, five miles below West Point, through the center of the Harriman section of the Palisades Park to Tuxedo. Since the time when it was opened four years ago it has carried heavy traffic continuously. Not only is this a favorite resort for motorists with speedy touring cars but any number of automobile trucks have also used it, and in addition steel-tired wagons and trailers have been hauled over it with traction engines, bringing wood and heavy timbers down from the forests. As a result this road, which is of bituminous macadem placed in three layers on a base of hand-laid telford, had been worn until the entire surface resembled that of a grindstone.



Dust is blown from roadway in Palisades Interstate Park, on the Hudson, by use of compressed air machine

In order to insure a proper bond, men first swept the road carefully with wire brooms. After that a small portable air compressor equipped with two hose was hauled along the highway immediately behind the gang of sweepers and all of the dust was effectually blown from the surface of the road. In this manner the outfit covered about half a mile of roadway each working day and left the bed in excellent condition for the work that was to be done. Then a seal coat of binder B was applied at a temperature of 350 degrees by means of a sprinkling truck. This truck was followed closely by a gang of men who spread on the seal coat a quarter inch of granite screenings, which were at once rolled in by a 10-ton roller. As a result of following this method, the road now has a surface that is wearing well and is giving general satisfaction.

This work was done under the general direction of Major W. A. Welch, chief engineer of the Palisades Interstate Park.

Machinery has been invented that sprays concrete on the interior of tunnels and almost immediately smooths it in place with swinging arms.

HOOVER FOR ST. LAWRENCE RIVER WATERWAY

Herbert Hoover in a recent address before the Western Society of Engineers urged the construction of the waterway from the Great Lakes to the Atlantic seaboard by way of the St. Lawrence river. Mr. Hoover in outlining his solution of the problem of the American farmer in increasing production said in part:

I would like, however, to recall another partial remedy for this situation advanced many times by our engineers. That is, the possible help from improving the waterways from the Great Lakes to the Atlantic seaboard by way of the St. Lawrence river so as to pass full sea-going cargoes. It has already been determined that the project is entirely feasible and at comparatively moderate cost. The result would be to place every port on the Great Lakes on the seas. Fifteen states contiguous to the Lakes could find an outlet for a portion of their annual surplus quickly and more cheaply to the overseas markets. The result would be to take off a considerable portion of the peak-load on the trunk-line railways during the great crop-movement season. It would contribute materially to reduce this effectual stricture in the free flow of the farmer's commodities to the consumers. Of far greater importance, however, is the fact that the costs of transportation from the Lake ports to Europe would be greatly diminished and this diminished cost would go directly into the farmers' pockets. It is my belief that there is a saving of five or six cents a bushel in the transportation of grain. Although a comparatively small proportion of our total grain production flows to Europe, I am convinced that the economic lift on this minor proportion would raise the price of the whole grain production by the amount of saving in transportation. The price of export grain in Chicago in normal times is the Liverpool price, less transportation and other charges, and if we decrease the transport in a free market the farmer should get the difference. Not only should there be great benefits to the agricultural population, but it should be a real benefit to our railways in getting them a better average load without the cost of maintaining the surplus equipment and personnel necessary to manage the peak-load during the fall months. It has been computed that the capital saving in rolling-stock alone would pay for the entire cost of this waterway improvement over a comparatively few years.

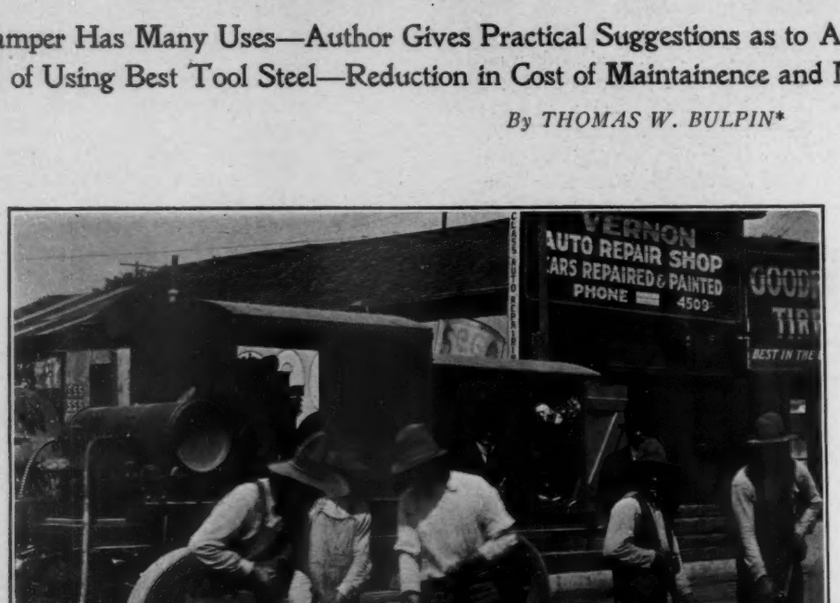
The matter also becomes of national importance in finding employment for the great national mercantile fleet that we have created. In other words, instead of expending vast sums on the development of our tracks, rolling-stocks, and terminals of the trunk-line railways, we should effectually substitute the other arm of transportation which we have already built, that is, our fleet.

Machinery that trims the scalloped edges of embroidery at about 50 times the speed of hand workers has been invented in Switzerland.

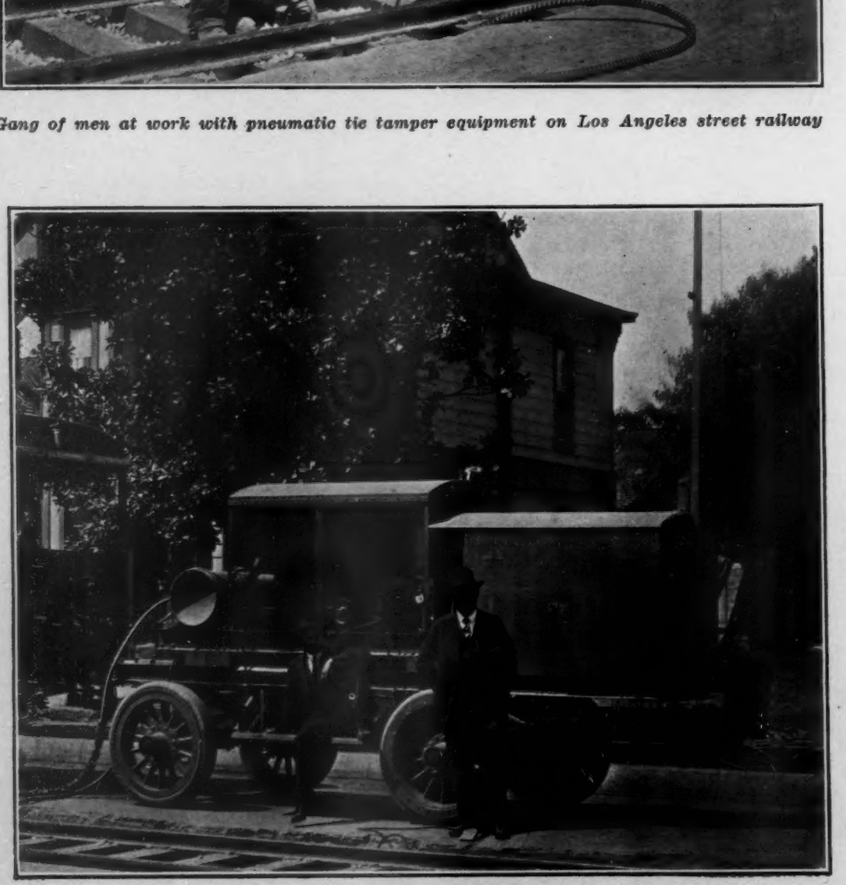
Use of Pneumatic Tools in Track Construction

Tamper Has Many Uses—Author Gives Practical Suggestions as to Auxiliary Tools and Shows Importance of Using Best Tool Steel—Reduction in Cost of Maintainence and More Uniform Quality of Tamping

*By THOMAS W. BULPIN**



Gang of men at work with pneumatic tie tamper equipment on Los Angeles street railway



A portable tie tamper outfit for use on street railways

IN THE early part of 1919 the Los Angeles Railway Corporation purchased a pneumatic tie tamper in order to minimize the use of high priced and inefficient labor. The results so far have been very satisfactory. We find that with the use of this machine we have been able to construct a much better track than heretofore, and at a very considerable saving.

The machine, when delivered at our yard, was mounted, as customary, on the ordinary flanged-wheel truck. As this mounting required the use of tracks upon which to operate, the truck was removed and the machine was set on a four-wheeled trailer, making it possible to transport it to and from the work by an ordinary auto car, and to station it alongside the track where it would not interfere with the operation of service cars.

Some slight improvement has been made in the trolley pole, also, making it possible for cars to operate through or under the point of contact without necessitating stoppage of the machine or attention from the operator. This trolley pole, or "stinger," as some people call it, consists of an upright pole which can be fastened to the machine, hinged at about the height of the trolley so as to permit the wire which connects with the motor to make contact with the top of the trolley wire. No difficulty has been experienced with this pole, and it saves not only the services of one man, but does away with the stopping and starting of the machine and the consequent loss of time.

While no accurate estimates have been made of the efficiency of this machine, nor of the actual saving of money it effects per track-foot, we do know that with this equipment and about six men it is possible to do the work of probably from twenty to twenty-four men. This is quite a saving, especially when one considers the inefficiency of the average laborer now available for this kind of work. However, the saving in money is not the principal element of efficiency. The fact that it is possible to construct track which is thoroughly and scientifically tamped—thus minimizing the chance of poor work being done by individual workers—is in itself worth many times the cost of the equipment.

While we appreciate the usefulness of this machine as a tie tamper, we believe that its greatest value is as an excavator of concrete paving. To adapt it for this purpose, a set of C.C.25 drift-bolt drivers are used. These tools are fitted to ordinary steel gads, which are driven through the concrete base of the pavement, breaking it into pieces sufficiently small for removal by hand. Our experience with this class of work has been most trying, and we have found that under ordinary condi-

*In the Electric Railway Journal.

tions it is best to remove the asphalt wearing surface by the usual methods, reserving the drift-bolt drivers for the concrete. We have used this machine for excavating, breaking concrete and tamping in and around special work in busy street intersections, where speed is usually of the first importance, and instead of being obliged to marshall all the forces of the department, we find that we are able, with ordinary sized gangs, to be ready in the morning for the first car.

As to the cost of excavating concrete pavement, we had occasion to construct a piece of double track in a street already paved, the pavement consisting of a 6-in. concrete slab, with a concrete wearing surface which was not of the ordinary contract variety, but a job constructed by the municipality; and if I am any judge it was "some concrete." Seven-foot trenches were required for our ties. We found that the most economical method was to cut a trench not over 12 in. wide along one side of the 7-ft. strip, then with bars and hammers to break out the balance of the work. The cost of this work was about two cents per square foot.

I wish to add a word regarding the tamping bars and steels necessary for gads. It is not advisable to attempt too much saving in the selection of steel for these tools, as ordinary steel will not stand the strain to which the tools are subjected. Our experience has shown that the better policy is to have the compressor company furnish the tools, or at least the steel, as delays are costly. While we have broken a great many home-made tampers, the original set which came with the equipment is still in use and has not been broken.

We have also purchased grinders, drills, and other useful tools which can be operated with the same equipment, making it possible to meet any ordinary requirement connected with track work; and as we have another of these machines on the way, it is needless to say that we believe in them, and are more than satisfied with the results we get from them.

NEW PRESSURE AND VOLUME INDICATOR DESCRIBED

The Bacharach Industrial Instrument Company, Pittsburgh, has developed a pressure and volume indicator for use in connection with the regulation of the blast for cupolas. It is evidently applicable in other situations where large volumes of air or gas are transmitted rapidly at low pressures.

The instrument, as shown in the accompanying illustrations, consists of a Pitot tube which is inserted, Fig. 2, in the blast pipe and connected to the pressure and volume indicator. The connection from the static opening of the Pitot tube has two branches, one leading to the pressure gage, which gives the static pressure of the blast, and the other to one side of the volume indicator. The connection from the impact opening of the tube is led to the other side of the volume indicator. This indicator is an inclined tube gage, completely inclosed so as to be dust proof, and is filled with a liquid which will

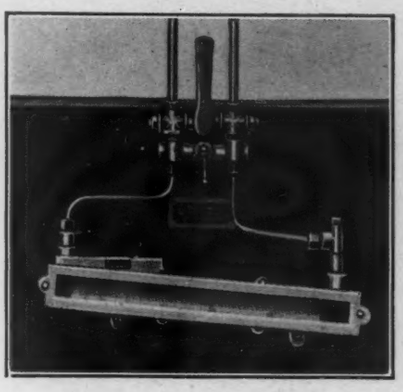


Figure 1—Indicator in place

not freeze or evaporate. The scale is graduated to read in cubic feet of air delivered per minute. By means of the linked valves in the connection to the instrument the zero of the indicator can be checked at any time without breaking any of the connections. The pressure gage is of the single tube type, and

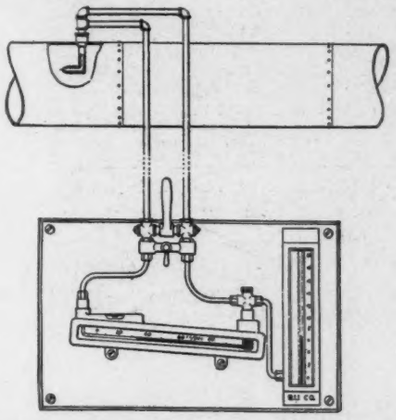


Figure 2—Sketch of Indicator and connections

is V-shaped so as to be easily read. It is graduated to read in inches of water. The Pitot tube has large openings so that there is little trouble from clogging due to the dust in the blast.

"Four Reasons Why You Should Be Careful," is the title of a six-page folder issued by the dust explosion investigating agency of the U. S. Grain Corporation, which is in the charge of David J. Price. The four reasons are displayed pictorially, showing Loss of Property, Loss of Life, Loss of Food and Loss of Job, in the ruin and wreckage of a mill and elevator.

The lesson of the four reasons is followed by some brief directions, "How to be Careful." The reader is told to look over the elevators and conveyors often, to report at once any rubbing, slipping, friction or other trouble, no matter how slight, and finally to observe the following injunctions:

Never smoke in or near the mill or elevator.

Never strike a match anywhere on the premises.

Never use open flames, torches, candles, lanterns, or unprotected light bulbs in dusty air or when examining bins or elevator legs.

Never let dust accumulate on beams, machines, pulleys or floors.

Reconstruction Days

At the present rate 200 years will be needed to finish mapping the world, says the *Indianapolis News*. Great areas remain unexplored, and little is known of millions of square miles of land. By using the airplane for map making this work may be done in the next twenty years. Instead of climbing mountains and laboriously measuring the land foot by foot, we shall do the work while flying at a hundred miles an hour. A special camera is placed in the bottom of the car and photographs are taken automatically, so many to the second or minute. These photographs are then fitted together in what is known as a mosaic map, which shows every house of towns or cities and every road and tree of the country. No such maps have ever been made before. The aero map is one of the inventions of the war which will prove invaluable.

To the eye of an observer in an aircraft a submarine and a whale had very much the same appearance provided both were some distance below the surface of the water, says a writer in *La Nature*. This possibility of confusion resulted disastrously to whales in three cases in the North Sea and in one case west of Ireland. In three cases the wounded animal came to the surface. In the fourth case the crew of the dirigible were so certain of their conclusions that they announced by wireless that they had destroyed a submarine, and the news appeared in print. To their discomfiture the mangled body of a whale came to the surface somewhat later in the presence of a torpedo boat.

John Skelton Williams, Comptroller of the Currency, has compiled returns of national bank deposits in reserve and central reserve cities on a comparative basis between the dates of November 17 and December 31. In the aggregate there was a net increase of deposits in the cities of $193,385,000, but in that connection it must be remembered that in the last two years deposits in all sections increased enormously.

About two-thirds of the world's annual consumption of cobalt is produced by the mines at Cobalt, Ontario, yet the metal is only a by-product. The 1917 production of these mines was 155 tons of nickel, 337 tons of cobalt, and 2592 tons of arsenic, besides 19,401,893 oz. of silver, and the silver represented a value of $16,121,013 out of $18,028,597 for the entire output.

The National Association of Manufacturers of the United States, the British Committee on Commercial and Industrial policy after the war, and the Canadian Manufacturers' Association, after carefully investigating the metric system, individually and collectively report that they are not convinced that the metric system is upon the whole even theoretically superior to the British system, and are satisfied that objections to the proposed change outweigh advantages which are claimed for it.

Notes of Industry

Roger C. Sullivan, chairman of the board of directors of the Independent Pneumatic Tool Co., Chicago, died at his home in that city on April 14. He had been ill for several months and heart disease is given as the immediate cause of his death. He also was president of the Great Lakes Dredger & Dock Co., being elected to that office late in 1918, succeeding the late W. A. Lydon, shortly after he was elected chairman of the Independent company board, succeeding John P. Hopkins, deceased. Mr. Sullivan was a Democratic leader of national prominence. He was born 59 years ago.

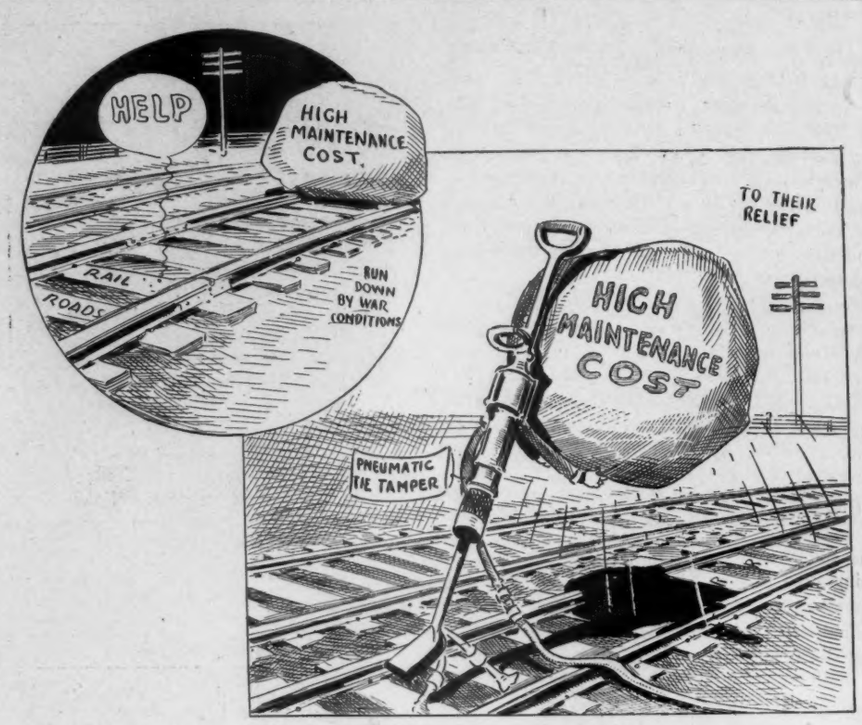
H. M. Davis died recently at his home in Brooklyn, N. Y., after a lingering illness of about three weeks. Mr. Davis was associated for a number of years with the Sprague Electric Works.

Frederick D. Underwood was reëlected president of the Erie Railroad for his nineteenth consecutive term. Other officers elected were: George F. Brownell, vice-president and general counsel; George H. Minor, vice-president and secretary; George N. Orcutt, vice-president; Thomas C. Powell, vice-president, and William J. Moody. The directors voted approval of J. J. Mantell, manager of the New York region, and his methods of handling the harbor and rail strikes and the protection of the company's interests.

The Union Oil Company's annual report for 1919 shows net profits, after charges and Federal taxes, of $10,638,253 against profits of $6,023,139, earned in 1918. Its gross profits for 1919 were $20,532,487 against $14,364,694 in 1918 and expenses and taxes totalled $2,037,611 in 1919, against $1,368,077 in 1918.

Present demand for General Electric Company products is greatly in excess of the capacity of its factories, according to C. A. Coffin, its president, in his annual report to the company's stockholders. At the close of 1919 the amount of orders unfilled was $98,880,000, against $80,000,000 at the beginning of the year. The amount of sales billed, according to the report, was $229,979,983 in 1919, or $13,164,706 more than in 1918 and $33,053,666 more than in 1917. The orders received in 1919 were $237,623,932, against $234,134,037 in 1918.

The Buckeye Castings Co., Lima, Ohio, has purchased compressed air machinery to be installed in its plant at a cost of $10,000, according to a statement of Mr. John Sonnenfeld, the president. The new machinery includes an air elevator, air moulding machine and an air compressor. Mr. Sonnenfeld stated, that with the installation of the new machinery, the Buckeye plant would become one of the most modern foundries in Ohio. The company also intends to generate its own power. Carl Leinbert was re-elected vice president, and Lou P. Stephens, secretary and treasurer.



LIFTING THE BURDEN OF UPKEEP WITH ECONOMICAL EQUIPMENT

An attachment for alarm clocks to awaken deaf persons by jarring their beds has been invented in Europe.

Germany's potash production of 550,000 tons in January was the greatest of any month since the mineral was mined in that country.

An amended certificate of incorporation was filed recently in the Secretary of State's office by the Crucible Steel Company of America. It increases its capital stock from $50,000,000 to $100,000,000, of which $25,000 000 is to be preferred and the remainder common of $100 par value. The preferred stock, according to the certificate, may be extended by its directors. It is stated that 250,000 shares of its preferred and 250,000 shares of its common have been issued by the corporation.

Several months ago it was announced that the Imperial Government Railways of Japan intended to bore a tunnel under the Shimonoseki Strait. This strait separates the main island of the Japanese group, Hondo, from the smaller island of Kiushu at the south. It is now crossed by a train ferry, which is rapidly becoming insufficient to meet the demands that are made upon it. Two years are to be spent in studying the geological formation of the sea bed in the strait and in drafting the general plan of work in preparation for the actual tunnelling operations, so that the real work will not commence until well on in 1921. Engineers and workmen will be sent to America and Europe to make a study of what has been achieved in those countries in the way of tunnel engineering. The line is to be seven miles long, one mile of which will be entirely under the sea.

Timothy H. Hickey, inspector of maintenance for the Michigan Central railway for the last 50 years, died recently of pneumonia at his home in Detroit, Mich. Mr. Hickey was 68 years of age and is survived by his widow and six children.

The government of Ceylon is considering the establishment of a gem industry in crown owned territory close to a rich gem district.

Heavy demand for coke by-products and high prices prevailing are causing the expenditure of millions of dollars for by-product coke installations by iron and steel makers throuyhout the United States. In the Mahoning Valley, for instance, there are 533 by-product coke ovens and some of the products, at present quotations, are more valuable than the steel produced in the contiguous mills. Sales of coal tar distillates are being negotiated chiefly for spot shipment. Demand for benzol is growing, while the market for toluol, solvent naphtha and naphtha products continues strong.

Extension of hydroelectric projects in Japan will involve the building of about 1000 miles of high tension lines within the next two years.

Sufficient potassium salts have been discovered in deep salt wells in China to promise a new source of potash.

To instruct its foreign-born employees and members of their families in the fundamentals and to assist them in obtaining citizenship papers, the Standard Tank Construction Co., Masury, Pa., has instituted a school in Americanization which meets every Tuesday and Thursday evening in a plant building.

RECOVERING DIAMONDS BY DIVING BELL WITH AIR LOCK

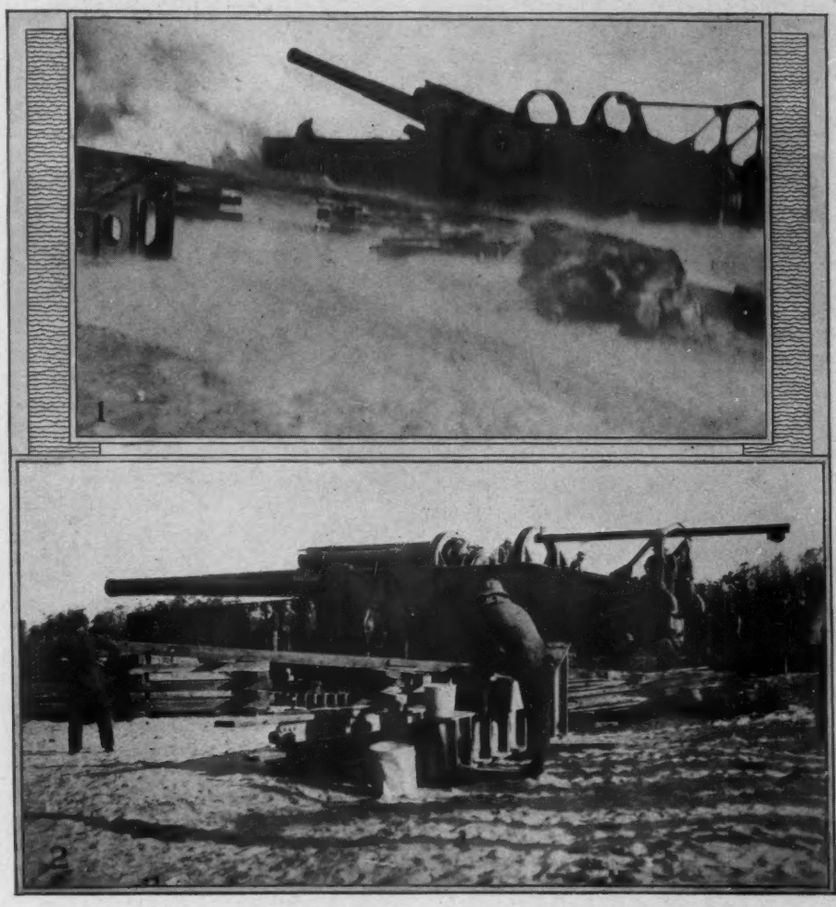
DEEP IN the Vaal River, in South Africa, are diamonds. To get them, we are told by *The South-African Mining and Engineering Journal* that a device on the diving-bell principle is to be employed, having a tubular shaft and an air-lock. The paper tells us that the device is the invention of Fabian M. Cox. and that it consists of two pontoons, rigidly connected by decks, between which a roomy caisson or diving-bell is sunk to the river-bed. A tubular shaft joins the caisson to a chamber above the water-level, and the whole is air-locked. To keep the caisson submerged. it is weighted with iron ballast, and the chamber above the water-level has a concentric tank filled with water, which can be adjusted to carry the necessary weight.

Compressed air is forced into the interior of the upper, or air-lock, chamber, the shaft and the bell, or caisson, and the river water being thus forced out below, it is possible to carry on digging and loading operations conveniently. The gravel is hoisted up the shaft and delivered into a chute which holds about a ton. When filled, it is discharged by a mechanism of double doors, which prevents the escape of compressed air from the interior of the various caisson compartments. Safety is provided by means of the free communication of the bell with the upper or air-lock chamber through the shaft and ladderway and by an easily opened manhole above.

The following notes are taken from the provisional patent specification: The present invention has reference to caissons or diving-bells of the air-lock type, and in this instance is designed for the recovery of the gold or precious stones from deep waters. The invention consists of providing a diving-bell having a tubular shaft and air-lock with means of quick vertical adjustment through the agency of solid and liquid ballast and suitable guiding frame, and means of elevating minerals by (a) submerged pump, or (b) suitable hoist.

"The following is a description of apparatus constructed according to this invention, and in this instance it is presumed to be for purposes of diamond recovery: A metal cylinder or bell, having a dome roof which is surmounted with a tubular shaft in sections to suit the depth of water to be worked, is terminated by an air-lock chamber surrounded by a water-ballast tank. The dome roof of the bell is provided with means of securing and at will releasing a quantity of solid ballast. The tubular shaft is furnished with external runners, which engage in rollers or guides attached to the deck of a pontoon or raft, which carries an engine, air compressor, and centrifugal pump, and possibly a plant for the treatment of the gravel or material recovered. The air-lock chamber is provided with the usual manhole door and equalizing valve, together with an air-lock chute for discharging gravel, a special door closing the entrance to the tubular shaft, which latter is furnished with ladder-rungs and runners for skipway, operated by a hoist fixed in the air-lock. The base of the shaft where it enters the bell is fitted with an air-tight door, which may be used when it is necessary to lengthen the shaft. The bell is provided with collapsible seats attached to the wall for the accommodation of workers during lifting operations, and with a centrifugal pump or hydroejector having a flexible suction, by means of which the loosened gravel is deposited in the kibble or skip hoisted to the air-lock or elevated direct above water level to the deck of the pontoon.

Fourteen-Inch Mobile Coast Defense Guns of Uncle Sam.



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The upper view shows the actual firing of the first shot from the new thirty-mile guns for defending our coasts. These guns are mobile and may be removed from their emplacements and transported by rail to other vantage points. The gases from these guns are expelled after firing by means of compressed air jets and repairs are made by means of pneumatic tools. Portable air compressors on five ton trucks were used during the war for operating pneumatic drills in repairing large naval rifles on railroad mounts.

The lower view shows the make ready for firing from the new thirty-mile gun in the first tests at Fort Story, Norfolk, Va. Tests of these guns in target practice at long range are soon to be made.

SAFFORD BECOMES PRESIDENT OF RAILWAY ASSOCIATION

H. R. Safford, assistant to the president of the Chicago, Burlington & Quincy was elected president of the American Railroad Engineering Association at the convention recently held in Chicago.

Mr. Safford was born at Madison, Indiana. He graduated from Purdee University in 1895 and immediately after assumed a position in the engineering department of the Illinois Central Railway. He was promoted through various positions until in 1906 he became chief engineer of maintenance of way. In 1911 Mr. Safford became chief engineer of the Grand Trunk where he remained until he was appointed chief engineering assistant under the U. S. Railroad Administration.

Mr. Safford's activities have extended considerably beyond the limits of the engineering field. He has taken a prominent part in association affairs and possesses a wide acquaintance among influential railroad men. He was selected as one of the seven members at large on the Development Committee of the American Society of Civil Engineers in which connection he has contributed to expanding the influence of the engineer and coordinating the activities of this organization.

It is expected that the association under Mr. Safford's direction will benefit from his rich experience in railroad affairs and it will undoubtedly continue to occupy the important place it has maintained for many years in the transportation world.

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Editorials

COMPRESSED AIR TO BUILD BEAUTIFUL, CHEAP HOMES

AN OLD FORM of masonry known as *pisé*, or cob, formerly familiar in England and France, is being considered as a building material for housing projects in the United States. It is nothing more or less than a cheap masonry of compressed earth. STURGIS'S *Dictionary of Architecture and Building* says that the most suitable solid for the purpose is clayey, somewhat sandy loam, and vegetable earth. The practically dry earth is rammed in between the walls of wooden forms similar to those used for concrete construction and it is mixed with hay or straw to prevent it from cracking when it dries out thoroughly. All stones of walnut size or greater are sifted out.

The *Literary Digest* calls attention to the ideas of THOMAS CRANE YOUNG of St. Louis, who believes this housebuilding method may be utilized for American cottages and bungalows at least. He speaks of the earthen house idea as a perfectly practicable and feasible undertaking. In France, houses two and three stories high have been built of pisé.

The wall of this house is built in sections by means of a movable frame about three feet high and ten feet long, the two sides of which are of boards kept apart the thickness of the wall. This frame is placed on the wall line and between its sides the earth is rammed or beaten in about four-inch layers. When the frame work is full, it is taken apart and set up in another place.

The London *Sphere* in describing these earthen walls, states that the earth hardens to an astonishing degree in the process of drying off; so much so that sometimes it is difficult to bore into it with an auger. The outer surface can be color-washed, or treated in various other ways. Spraying with hot liquid tar has been tried successfully. The natural wall, it is stated, weathers in course of time to a very attractive color, and the outer surface itself withstands ordinary weather action.

The St. Louis architect, Mr. YOUNG, suggests that for moist climates the walls would probably require water proofing. Our own suggestion is that this is a matter that might well be brought to the attention of the Cement-Gun Company of Allentown, Pa., for experimentation. It would appear at first blush to be perfectly feasilble to coat such walls both within and without with a coating of cement by means of a cement-gun. Such walls will no doubt be found to have, when treated in this way, all the permanency of walls of sturdier materials. Single-story bungalows of six or seven rooms can readily and cheaply be constructed, the earth from the cellar excavation work or from grading of plot being used to fill the forms.

Work would doubtless be hastened and cheapened by the use of compressed-air operated sand-rammers, such as are used in tamping the back fill of ditches, and in foundry and concrete block work, to tamp down the earth in the forms. As the cement-gun is operated with compressed air, like the sand-rammer, such houses might well be called "compressed air constructed houses." Portable air compressors would supply the air for the cement-gun and the hammer.

Apparatus could be shifted from one job to another on a housing operation where a number of houses are to be built at a time. The forms used on one house would answer as well for others, and ordinary unskilled labor could be used. Unlike in a concrete poured house, it is unnecessary to have forms built by carpenters for an entire house. Walls could be built in sections from moveable frame work, and this, too, would lessen expense.

Here, it appears to us, is a highly practicable method of building fine residences and garages, and even garden walls about them, at very low cost. The door and window frames can be set in as the work progresses on the walls, and the roof can be made of cheap materials and covered with gunite by the cement-gun. Such a house will be beautiful, permanent, fireproof and weatherproof. It can be quickly constructed at a great saving in outlay. It presents a good field for the contractor, a good proposition for the home-buyer, and means a speedy alleviation of the lack of housing accommodations due to the high costs of materials. It ought to be possible to build a six or seven-room house in this way in commuting distance of our large cities at a cost of $3,000, let us say, which with ample land, could be sold at a decent profit at about $4,500 or $5,000, and with purchasers ready to take them as fast as they can be built.

TO LOWER LIVING COSTS, TAX LAND, NOT BUILDINGS

IN A WORLD of high prices it is to be taken for granted that a most desirable goal is the lowering of living costs. The present governmental system of meeting public charges is to increase taxes on everything—except land. As taxes go higher on purchased commodities, labor goes up in price, rents go up, and all manufactured articles are increased in price to the ultimate consumer.

The thought of lowering taxation seems never to have been considered in our unscientific centres of government, excepting as perhaps shifting a tax from one commodity to another, or taking it off one class of customers to load it on the backs of others. The natural result is that the question of centering taxes on the land is again coming to the fore, and is being debated in public forums.

As a fundamental of economic government it would seem undeniable that the shifting of all real estate taxation from the improvements or buildings on land, to the land itself, would be the part of sanity and logic. Under the present system, if one buys a parcel of land he is penalized if he erects a building upon it. On every cent he puts into "improvements" on the land he must pay taxes. His enterprise in adding to the value of his community, in giving employment to practically every trade and every branch of industry, is subjected to a fine.

Now what would happen if the taxation were confined wholly to the land itself? If the land were taxed on a basis of what its owner would accept for it if he were selling it—which should be the foundation amount for the tax—the owner would not keep land idle or unproductive very long. If he did not have the money to "improve" it, he would be glad to sell it for what it would bring, rather than pay out cash on property that brought no return. This would stimulate productivity on the land. It would increase agriculture, lumbering, manufacturing and encourage residential construction. The landlord would very soon be seeking the tenant, instead of the tenant seeking for a landlord, as happens at the moment to be the case.

Increased productivity, which we are seeking to obtain with all our might and main in America today, would mean lowered prices but more prosperity on a sound basis. The workman would be content and so would his employer. It is a very comforting picture now painted by the proponents of the land tax, who have many strong arguments and much good reasoning on their side. This does not mean a "single tax" by any means, for we could still keep some of our archaic system if we chose. Probably we would feel homesick without it.

Raising the billions necessary to cover our present crushing requirements would be comparatively easy under the land tax principle and it would be certain to bring benefits rather than hurts in its train. Besides it would be a thinly distributed tax in the national sense. If the States and cities followed suit we would begin to approach an economic millenium, our

land tax friends aver. Europe has changed, and our part of the world is changing, as our thoughts unfold and our viewpoints change. May we not profitably give heed to the subject of revising the basic principle of our taxation system, especially in view of the fact that we now stand in this regard about where England did in 1760?

HEATED AIR AND GAS MIXED TO CUT FORD FUEL COSTS

AN INVENTOR of Memphis, Tenn., Mr. DENNIS J. PLEDGER, after seven years of hard work perfected a device known as the Pledger Gas Saving Accelerator, which has now been patented and placed on the world market by the firm of HORNE & LE BLANC of New Orleans, La. By means of this remarkable appliance the common or boulevard variety of automobile manufactured by Mr. HENRY FORD of Detroit is made to travel a minimum of 50 per cent more miles to the gallon of gasoline. The invention is first being applied only to Ford cars, of which there are said to be some 4,000,000 in the United States, but is later in the year to be made available by the manufacturers to all makes of cars, and subsequently to nearly every type of internal combustion engine. Almost innumerable tests of Mr. PLEDGER'S wonderful invention have been made in various parts of the United States to the satisfaction of observers. Tests made in the vicinity of Greater New York by the Automotive Appliances Association of No. 63, Wall Street, showed a minimum increase of 60 per cent to the mileage of a car per gallon of gasoline. The device was subjected to every sort of trial, both in public and privately, and is now being sold by the thousands. It has created a sensation in motoring circles of the metropolitan area.

The PLEDGER appliance does its work, after the carburetor has finished its function, by applying heated air into the intake manifold through a special valve constructed of red bronze. The heated air is obtained from a brass heater attached over the exhaust manifold. This heated air is fed to the engine at the same time as the gas, and at the various speeds of the engine, causing the flow of a perfect mixture into the combustion chamber and therefore causing a perfect explosion, simultaneously overcoming the refrigeration and condensation that take place under the old system after the gas has left the carburetor. It does not make the car either harder or easier to crank, nor does it increase the miles per hour—it just saves gasoline and causes the engine to run more smoothly. The engine does not *sound* like a Ford when the appliance is installed, as it runs with a soft purring noise like a Packard twin-six engine.

By means of the device, too, carbon deposits are prevented from forming within the engine, this being due to the high percentage of combustion. One drives his flivver with a foot accelerator, as in the case of larger and more expensive cars, leaving both hands free for steering and the signal horn, adding a considerable safety factor. The throttle lever on the steering wheel is utilized only at the start and until the car has travelled a few hundred feet to warm up the engine.

With the price of gasoline soaring this remarkable invention is a significant addition to internal combustion motors. Under highly favorable circumstances the PLEDGER appliance has caused mileage increases of from 100 per cent to 140 per cent. Cars have been driven from a minimum of 25 miles up to a maximum of 40.2 miles to the gallon. In an official and public test in New Orleans an ordinary five-passenger touring Ford was driven 364 miles on ten gallons of gasoline. Police and fire departments of various cities have equipped their cars with it, and the application of the device to their own cars has been ordered by the Standard Oil Company and the Texas Company.

The further extension of the usefulness of the PLEDGER appliance as regards marine and stationary power engines is awaited with the greatest interest, as it means that when gasoline is selling at 33 cents a gallon, its cost to the user of the device will be from 20 to 22 cents. It is predicted that gasoline is going to 50 cents a gallon in the United States. It is now selling at 65 cents a gallon in Cuba and a dollar in many parts of South America. Oil companies declare that consumption is 30 per cent beyond production and that they are utilizing their reserves.

CAN'T THE OLD-FASHIONED BLUE-PRINT BE RETIRED?

THE ABOVE heading would seem to carry a suggestion almost as preposterous as would be (a) query concerning the continued tarrying with us of the multiplication table; and yet if we consider a little the question which Mr. FRANK RICHARDS propounds on another page of our present issue as to "Why the Blue-print?" we find considerable cause for hesitation in the rendering of a sharp decision. The matter is presented in our columns not by any means with full endorsement, but as deserving, if not demanding, serious thought and discussion.

We all know the great service the blue-print renders, and its general indispensability throughout the broad reach of our industries, but also we cannot forget the inconveniences, the annoyances, the general savor of dissatisfaction which accompanies its use; but it is useless to call attention to these deficiencies unless something distinctly better is at the same time proposed. If all that the blue-print does can be done as efficiently and completely as of old, while the objectionable accompaniments can all be superseded by added conveniences and comforts, and all with appreciable reduction of ultimate cost, the appeal becomes at once a working business proposition.

The matter is eminently discussable as presented, yet, curiously enough, there are no uncertainties to be considered and no undetermined conditions involved. Every one can clearly understand the discarding of the tracing and the blue-print as proposed, the substituting of the photo-engraved plate made from the finished drawing, and generally upon a much reduced scale, and then the printing from the plate of black lines upon white paper, as would be most welcome. No new information is required as to any operation involved and no skill is called for that is not already available. So far as the mechanical execution of the scheme is concerned there can be no question as to its entire and ready practicability.

To the established habit and practice of the drawing room the proposition to abolish the blue-print must come as a sharp shock, and little less must be the disturbance wrought upon the mass of industrial workers who these many years have had the handling of the blue-print in their daily activities. It is here where opposition would be instructive and inevitable and would be of a kind not to be overcome by talking over the matter ever so voluminously.

No satisfactory and conclusive decision can be expected except as based upon the actual doing of the thing proposed, and this we may hope to chronicle in the not distant future.

THE METAL, ZINC, SEEKING CREDIT FOR ITS USES

THE GENERAL public is being asked to call things *zinc* that are made of zinc. The request comes from the advocates of, and those interested in the use of the metal. They aver that zinc is "the world's most useful metal" but that it is losing its distinctive name. At last year's meeting of the Zinc Institute of America in St. Louis, attention was called to the fact that when *zinc* reached the public it was called something else. In the last year, ending with the May meeting of the Institute at Chicago, propaganda has been carried on to educate the public and the trade. In the coming year there will be a more intensive campaign.

Statistics produced reveal that zinc is one of the three principal non-ferrous metals, ranking with copper and lead in utility. In 1918, there was smelted nearly 600,000 tons of the metal. Further facts show that one-half of the annual output of zinc was being consumed in coating steel sheets and wire to give that metal longevity when exposed to atmospheric influences, but zinc, as a metal, received no credit for the immense benefits thus yielded, the product being marketed and generally known as "galvanized steel." Nearly 40 per cent of the world's production of zinc is used for alloying purposes with other metals, but the product is thereafter usually called brass, and the name zinc is lost in the compounding. Barely ten per cent of the gross tonnage of zinc is rolled into sheets, which is the only form of the metal with which the public is acquainted.

Even in the form of sheets the metal is so often concealed in humidors, on the inside of refrigerators, tea caddies, ammunition boxes, where it keeps out atmospheric influences, that the average citizen never sees it or knows of its useful properties.

Shoe lace and corset stay tips and glass can tops are other forms in which flat or sheet zinc is used. Zinc plays a prominent part in medicines; it is a principal factor in giving wear and strength to automobile tires and a small

per cent of zinc, when compounded with aluminum, gives a hundred fold increased strength to that metal.

Zinc oxide is a principal ingredient in the best paints. A thin sheet of the metal encases all dry batteries. It has wide uses in the printing arts. The telegraph, telephone and cable wires throb with life only because zinc is the negative pole of the battery that impels the message to its destination.

But it is in the use of zinc for roofing that the public is making increasing inquiry. This present day questioning is directly traceable to the fact that zinc sheets have been extensively used for roofings in Europe for more than a century. Several millions of our best citizens made a journey recently to ancient Gaul and the surrounding cantons, and saw building materials in all stages of wear and tear and disorder, that demonstrated the ability of such materials to withstand rough usage and ill treatment. Our soldier visitors to France were particularly impressed with the wearing and recovery properties of zinc for roofing purposes. These roofs had not only lasted as long as the masonry and other materials of the structures but had also showed that even as junk, zinc still possessed a value. The Hun in his retreat to the right side of the Rhine carried away much of the gutterings, eave troughs and conductor pipes, which had big values in metal-impoverished Germany.

Zinc sheets have been used extensively for roofing in central Europe for more than 80 years. Some roofs are extant on the continent that were installed as early as 1813. Just prior to the war, England and the adjacent continent were using more than 100,000 tons annually of sheet zinc in roofing the better structures of that section.

When a sheet of zinc is exposed to the atmosphere, it forms on the immediate surface, a thin film of hydro-carbonate of zinc that is flinty hard and forever seals the inner metal against further contact. But for physical abrasion, a sheet of zinc would last indefinitely even under weather exposure.

Having learned something of this cheap and permanent form of roofing as applied in Europe, the returning American is seeking similar materials. It is expected that the several hundred manufacturers who are now forming roofing accessories out of other metals will be prepared to offer the same materials in zinc.

And if they do, The American Zinc Institute asks and urges that the product be called *zinc*.

WHERE MANY OPPORTUNITIES ARE FOUND TO "GET AHEAD"

IN HIS *Golden Rule* articles, NAPOLEON HILL tells how a little old stoop-shouldered woman walked into one of Pittsburgh's large department stores one rainy day and wandered up and down the aisles. She didn't look like "ready money," therefore the clerks "didn't see" her, with the exception of one new and green employee.

This young man was not one of the regular clerks. He had only been with the store a few days. He stepped up to the old lady, helped her with her purchase, escorted her to the door and raised her umbrella for her.

As she left she asked for his card!

Later an order came to that store for furnishings for one of the finest mansions in the world. With the order came the request that this same young man be sent to oversee the installation of the furnishings. The manager of the store protested that the young man was inexperienced; that the store had more experienced men; but the customer insisted that this young man was the one she wanted to oversee the work.

The customer who placed the order and requested the services of that young man, was Mrs. ANDREW CARNEGIE; none other than the little old lady to whom this young man had shown unusual courtesy while all the other clerks were looking in another direction.

Opportunity knocked at that man's door and found him in!

Opportunity seldom comes in silks and satins; it seldom is heralded with the blowing of horns or led by a brass band. It usually sneaks up to us when we are not expecting it. Opportunity stands at our side from morning until night. Every time a little old lady comes along near us opportunity comes with her—opportunity at least to be courteous and receive happiness from our efforts. Every time there is work to be done which no one else wants to do, opportunity beckons us to step up and embrace her, because it is here that the first step toward leadership is taken.

The poet who wrote that opportunity knocks but once, did the world a tremendous damage!

Every time a person does one an injustice, declares Mr. HILL, he is face to face with opportunity—a glorious opportunity to prove to himself and to the world how big he is by applying the Golden Rule, forgiving and forgetting.

Every time one has a chance to get the better of his fellowman in a business deal he is face to face with opportunity—opportunity to increase his own self-respect and gain the confidence of his fellows by doing the unusual thing in not taking advantage of that chance.

It makes no difference what may be one's calling in life, or how lowly the work he is doing at present, he has a freeman's opportunity to raise himself into more important and more profitable work by the simple process of performing more service and better service than he is actually paid to perform.

One may know where his neighbor keeps his family skeleton. It could be dragged out to humiliate him. What a wonderful opportunity to be big enough and great enough to let that skeleton remain undisturbed.

Your competitor "knocks" you and tries to take away business to which you are entitled. Here is a fine chance merely to remain silent and permit him to defeat himself with his own weapon.

The world may say unkind things about you. What a wonderful opportunity you have to prove the world all wrong by your good conduct, your kindness toward your neighbors, your fair dealings in business, your own example of forgiving and forgetting.

* * *

Mr. HILL has his headquarters in Dallas. He gets about the country a good deal in his gathering of helpful materials for constructive living. He relates how one day when in the town of Wichita Falls, Texas, he perceived a one-legged man sitting on the sidewalk begging. A few questions brought out the fact that he had enjoyed a fair education. He said he was begging because no one would give him work. "The world is against me and I have lost confidence in myself," he said.

There was the whole difficulty:

"I have lost confidence in myself."

Across the hall from Mr. HILL's office is another one-legged man, whose schooling was slight. He had less training, says the Texas writer, than the one-legged beggar. But, he is earning a thousand dollars a month. As sales manager of a manufacturing concern he is directing the efforts of fifty men.

The beggar displayed the stump of his amputated leg as *evidence* that he needed *alms*. The other one-legged man covered up the stump of his lost leg so it would not *attract attention*. The difference between the two men exists merely in viewpoint. One believes in himself and the other does not!

* * *

The world never defeats you until you defeat yourself. MILO C. JONES became a wealthy man out of the sausage business after paralysis had stricken him down and taken away the use of nearly every muscle in his body. He couldn't turn over in bed without aid.

As long as you have faith in yourself and that wonderful mind with which you were endowed continues to function properly, you cannot be defeated in any legitimate undertaking.

The HILL theory is sound, for his exposition is that if you are a failure, if you are unhappy and despondent, you may see the person who is most to blame by stepping to the nearest looking-glass! Unpalatable, but true! When one begins to succeed he may put it down as a sure thing that he has commenced to believe in himself.

The thoughts held in an individual's own mind are constantly being registered in the minds of those with whom that individual comes in contact. This is a scientifically proven fact. It may be seen then, how necessary it is for a person to think well of himself. It is why one ought to believe in his own ability to accomplish all that he undertakes.

The line which marks the difference between the successful and the unsuccessful man is definite and easily removed. One *believes* he can do all that he undertakes and goes ahead and *does* it; the other one believes he cannot accomplish *anything*, so he never *begins!* Mr. HILL suggests this formula:

"If you want to witness a marvelous transformation in yourself, commence now and for ten days stand before a mirror for ten minutes each day, look yourself squarely in the eyes and say—'I believe in you; you can finish everything you start; you can induce people to like you; you can get people to favor you by first favoring them; you can win peo-

ple's confidence by placing your confidence in them.' The result will be startling."

In the New York office of the general sales manager of a very large machinery manufacturing concern there hangs a sign which is the best commentary of the kind we have ever noted. It tells of a chap who was so simple that he didn't know a certain thing could not be accomplished, so he went ahead and did it! The greatest obstacle in the way of accomplishing anything will be found usually in the mind of the person who admits its desirability but is assailed by doubts!

At the International Hydrographic Conference held in London in the summer of 1919, 23 countries were represented according to the *Journal of the Franklin Institute*. The purpose was to compare and study the methods used in the several countries in order to determine the best among them and to standardize the hydrographic publications of all countries as far as possible. In the "Light Lists" now are included "wireless direction-finding stations" and "sound-ranging signal stations." It was recommended that all countries adopt "time zones" at sea, as Great Britain, France, and Italy have already done. A committee of which Rear Admiral Simpson, United States Navy, is a member was to present to the various governments the arguments for the establishment of an International Hydrographic Bureau.

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Book Reviews

STEAM TURBINES, a practical and theoretical treatise for engineers and students, including a discussion of the gas turbine, by JAMES AMBROSE MOYER. Fourth edition, revised and enlarged. Indexed and illustrated with drawings, graphs and photos. 500 pages. Price, $3.50. New York: Messrs. John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, Ltd.

THE LATEST edition of Dr. Moyer's fine work on the steam-propelled turbine mainly discusses new applications for it. The chapter on low-pressure turbines has been rewritten and very much extended to include the latest developments and applications, and it will be found unusually interesting to all engineers and students. The chapter on reaction turbine design has been entirely rewritten with special reference to the problems arising in the design of **combined** impulse and reaction types.

The author considers that present conditions in steam turbine practice make necessary a fuller discussion than in preceding editions of the methods of governing, the calculation of the strength of the disk type of blade wheels, and the recent developments in marine practice. These and many other changes will be noted in various chapters.

An interesting commentary by Dr. Moyer is that recent improvements in the economy of steam turbines are having an important effect on general industry. The low cost of power where coal happens to be cheap makes the large turbine-electric generating plant almost an unrivaled competitor of water power for metallurgical processes, such as the reduction of aluminum from its ores, and the refining of such metals as copper. Despite the general increase in the cost of raw and manufactured materials in the last five or six years, the application of steam turbines in power plants to take the place of reciprocating engines has reduced the total first cost of large first-class power plants from $120 per kilowatt of rated capacity, a fair average value of say the year 1914, to a present cost of from $60 to $75. Electro-chemical industries have also been benefited by the availability of this cheap steam power for the fixation of the nitrogen in air for use in fertilizers. The electric propulsion of ships has received much attention from engineers, and the further electrification of the eastern trunk-line railroads will follow rapidly, Dr. Moyer believes, with the assistance of cheap power from large steam turbine generating plants.

THE PHYSICAL CHEMISTRY OF THE METALS, by RUDOLPH SCHENCK, Professor of Physical Chemistry in the Technischen Hochschule in Aachen, translated and annotated by REGINALD SCOTT DEAN, Research Metallurgist, American Zinc, Lead and Smelting Co., St. Louis, Mo. First edition, 227 pages. Illustrated and with name and subject indices.

IN HIS PREFACE to his translation of Dr. Schenck's book Mr. Dean observes that there is perhaps no field where physical chemistry is of more value than in the field of metallurgy and metallography. In the latter field its usefulness has been recognized almost from the first but in the field of metallurgy its application has not been so general. Mr. Dean hopes that the translation may aid in making the value of chemical dynamics and equilibrium clear to the metallurgist and metallurgical student.

Mr. Dean has done more than merely translate this valuable work. Such additions as have seemed necessary have been incorporated in the text and the numerical data have been revised to agree with the accepted values. The book has been changed from lecture to textbook form and the references have been shifted from the appendix to the body of the book. The lectures were originally delivered by Dr. Schenck at Aachen in 1907 in the Technischen Hochsschule. Their purpose was to show the engineers of the Rhenish industrial district, before whom they were delivered, the use of chemical statics and to deepen their understanding of smelting operations and metallurgical processes. Not all of the experimental matter relating to the physical chemistry of metals has been considered in the volume, but all fundamental questions have been treated rather thoroughly. It is a book which should have a wide sale in this country.

PRACTICAL EXPORTING, a Handbook for Manufacturers and Merchants, by B. OLNEY HOUGH, editor of *The American Exporter*, and author of *Elementary Lessons in Exporting* and of *Ocean Traffic and Trade*. Fifth edition, revised 1920. Indexed and containing specimen documents, practical data, etc. 529 pages. Price, cloth, $5. New York: Johnston Export Publishing Co.

THE JOHNSTON BROTHERS and their gifted editorial director, Mr. Hough, are known wherever American trade finds its way abroad, and for many years these energetic and successful publishers have promulgated inspirational and practical literature for the encouragement and strengthening of our commercial relationships with business men overseas. The new edition of *Practical Exporting* is one of a series of highly successful books that gives sound advice, and, as its name indicates, practical help in coping with the problems of the foreign trade field.

Written by an authority on the subject, this book provides information on how to obtain and then how to handle export business. It has been prepared with a view to assisting the manufacturer, the exporter, and the student. The United States Shipping Board has recommended it as the best, if not the only single book on the subject in general. It will help solve problems of office and shipping practice, and the firm that is contemplating embarking on the complex seas of export trade should consult its pages before it even engages an export manager.

F. J. T.

The fortieth anniversary of the piercing of the Gothard tunnel between Switzerland and Italy was celebrated on February 27.

Absorption as applied to the recovery of gasoline left in residual gas from compression plants is discussed in *technical paper 232*, issued by the Department of the Interior, Bureau of Mines. In the absorption process the gasoline present in the natural gas is absorbed by oil and subsequently separated from the oil by distillation, or is absorbed in naphtha and marketed without any further treatment,

GROWING POPULARITY OF SMALL DRUM HOISTS

By L. H. GEYER

EACH year bings forth more uses of Compressed Air, new machines operating on compressed air, and additional applications of compressed air machines which are no longer new. The growing popularity of small, portable drum-type hoists offers an excellent example of this latter phase. Although these machines have been on the market for some years their users are constantly adapting them to work formerly done by hand.

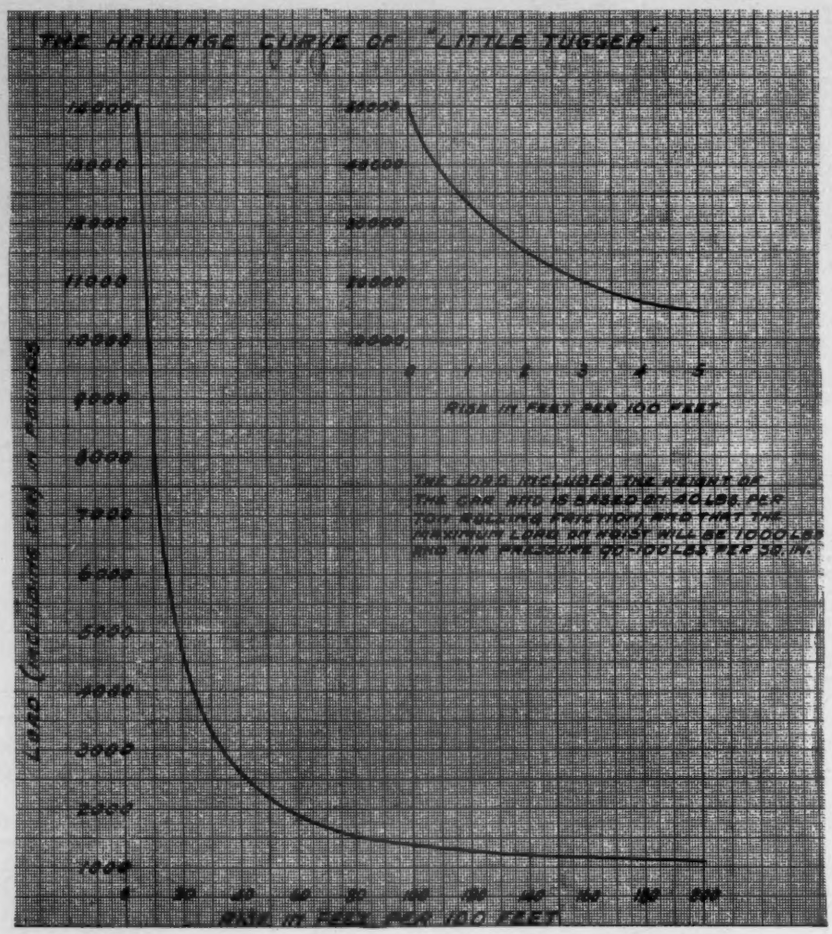
Consider, for instance, the manipulation of any of the following jobs in a mine: raising timbers, drills, mountings and drill steel, skidding and placing timbers and concrete forms, hauling ore or muck cars, installing machinery, or raising muck and ore buckets in shafts and winzes.

Many of these same problems must be met in contracting and quarry work, and in addition there is usually the problem of machine power for small cranes.

In shipyards, in addition to the above the problem of cleaning out hulls of completed vessels is one of real importance. Several yards have installed small air hoists at each hatch, which raise the scrap material from the hulls. On shipboard these hoists have been installed for lifting ashes from the pit to the deck level.

The above and countless other odd jobs are now being performed by small air hoists. Skilled men are no longer laying down their tools to answer the hurried and oft-repeated call of "lend-a-hand" here, there and everywhere. For years this "lend-a-hand" evil has cost many dollars, decreased the efficiency and slackened production. Often-times the odd jobs are so small that no notice is taken of them at the time, but were they all added up for a period of a month or a year the record would show astounding figures.

Little Tugger Hoist, Bilhara Mining Co., Joplin, Mo.


THE HAULAGE CURVE OF "LITTLE TUGGER"
RISE IN FEET PER 100 FEET
THE LOAD INCLUDES THE WEIGHT OF THE CAR AND IS BASED AT 40 LBS. PER TON ROLLING FRICTION AND THAT THE MAXIMUM LOAD AT HOIST WILL BE 1000 LBS AND AIR PRESSURE 90-100 LBS PER SQ. IN.
LOAD (including car) in POUNDS
RISE IN FEET PER 100 FEET

Curve shawing the car haulage capacity of Little Tugger hoists.

One of the most interesting uses of these small hoists is for hauling and shifting cars. Recent years have shown a steady and even amazing increase of their application for this service. One manufacturer has constantly recommended them for this service and has made up a curve showing the weight of loaded cars which the hoist will pull at various grades of track inclination. This curve is reproduced above.

These hoists are usually made so that they can be set up in practically any position. As they are used largely in mines they are provided with means of attaching to a drill column or column arm as well as for bolting to timbers. No special tools are required for this installation.

CENSUS OF MANUFACTURES

The Federal census of manufactures and mines and quarries has been under way since March 1, with a large field force engaged in collecting these statistics. The gathering of the data which the Census Act requires regarding the manufactures and mines and quarries of the country is under the immediate supervision of Eugene F. Hartley, the Census Bureau's Chief Statistician for Manufactures.

"A special feature of this census," states Mr. Hartley, "will be the presenting of the statistics of manufactures by industrial zones. In former census years statistics of manufactures have been presented geographically by states and by cities of 10,000 population and over, with a supplemental exhibit for from twelve to fifteen metropolitan districts. The general trend shown by large industrial enterprises seeking suburban locations, where the necessary space and adequate switching facilities may be secured at reasonable cost and without taxation at city rates, has created a new condition. To reflect this industrial expansion the Census Bureau at the current census will show as a third geographical unit, the industrial zone. The 69 largest manufacturing localities, those embracing a population of 100,000 and over, or practically those manufacturing sections representing $100,000,000 of manufactured products have been selected for a special presentation as 'industrial zones.'"

Each state and each city of 10,000 population and over, as at previous censuses will receive a separate and independent exhibit of the manufactures carried on within its limits and will not be affected by the survey by industrial zones. The exhibit of manufactures statistics by industrial zones will be additional data of special interest.

The cost of mining coal in Kwanski, China, is about $1 a ton, while the expense of transportation to harbor is $11 a ton.

Latest U. S. Patents

Full printed uncertified copies of specifications and drawings of any patent may be obtained by sending ten cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 30

1,334,952. FUEL-ECONOMIZER. Frank H. Harriman, South Glastonbury, Conn.

1. A fuel economizer comprising a flash generator heated by the products of combustion of the engine and having a vacuum chamber, said vacuum chamber communicating with the intake manifold of the engine and with a source of water supply, said water supply being located below the vacuum chamber and the water being raised to the chamber by the suction of the vacuum chamber, means for breaking the vacuum in said vacuum chamber, and a thermostat for controlling said means.

1,334,963. VALVE SET FOR COMBINED INTERNAL-COMBUSTION ENGINES AND VACUUM PRESSURE-PUMPS. Olof Ohlsson, Sodertelje, Sweden.

1,335,051. AIR-PUMP. Charles Benjamen Goodstein, Struthers, Ohio.

1,335,053. PNEUMATIC SECONDARY CLOCK. Charles Ballard Hale, Park Ridge, Ill.

1,335,124. METHOD AND MACHINE FOR REMOVING AIR FROM RUBBER ARTICLES. Thomas Midgley, Springfield, Mass.

1,335,173. APPARATUS FOR MILKING. Arthur Chichester Macartney, Bloomfield, N. J.

1,335,291. AIR-BRAKE APPARATUS. Spencer G. Neal, New York, N. Y.

1,335,448. FLUID-PRESSURE MORTAR AND THE LIKE. Vadakkath Ramunni Menon, Singapore, Straits Settlements.

1,335,476. PNEUMATIC ACTION FOR PIANOS. William G. Betz, Buffalo, N. Y.

1,335,477. VACUUM OIL-CUP. Harry F. Bloom, Toledo, Ohio.

1,335,478. CONDENSER SYSTEM AND VACUUM-PUMP. Phillips P. Bourne, Winchester, Mass.

1,335,533. GLASS-BLOWING APPARATUS. Frederick W. Stewart, Beaver, Pa.

APRIL 6

1,335,718. TIRE-INFLATING PUMP. Henry K. Austin, Reading, Mass.

1,335,792. VACUUM FUEL-FEED DEVICE. William H. Muzzy, Chicago, Ill.

1,335,807. SUPPORT FOR PNEUMATIC TOOLS. William Walker, Langside, Glasgow, Scotland.

1,335,898. FLUID-PRESSURE-OPERATED CONTROLLER. Owen Marshall Jones, New York, N. Y.

1,335,953. PULSATOR FOR MILKING-MACHINES. Henry B. Babson, Chicago, Ill.

1,336,078. SUCTION-CLEANER. Howard Earl Hoover, Chicago, Ill.

1,336,225. METHOD OF HUMIDIFYING AIR. Robert W. Hardie, White Plains, N. Y.

1,336,280. AUTOMATIC AIR-VENT. Patrick Carroll, New York, N. Y.

1,336,301. AUTOMATIC AIR-PRESSURE CONTROL. Alvin C. Kingsbury, Gig Harbor, Wash.

1,336,315. AIR-MOTOR. Earl Plemmons, Ashburn, Ga.

1,336,316. PNEUMATIC PAINTBRUSH. Frank Poicho, Melvin, Mich.

1,336,396. AIR-PUMP. Alfred Swensen, Cicero, Ill.

APRIL 13

1,336,457. AIR-COOLER FOR ENGINES. Jokshan F. Wittmann, St. Louis, Mo.

1,336,511. DIFFERENTIAL-PRESSURE GAGE. William James Crowell, Jr., Lebanon, Pa.

1,336,732. VACUUM-RAILWAY. Robert Ballard Davy, Hayward, Calif.

1,336,760. VACUUM-CLEANER. Claude W. Stewart, Martinsburg, W. Va.

1,336,822. APPARATUS FOR GASIFYING LIQUIDS. Edward H. Cuyler and Mark B. Patterson, Los Angeles, Calif.

1,336,905. METHOD AND APPARATUS FOR PREVENTING AND REMOVING OBSTRUCTIONS IN FLUID-PRESSURE SYSTEMS. Walter W. Hunsicker, Mansfield, Ohio.

1,336,930. ROCK-DRILL SEATING AND CONTROLLING MEANS. Harold I. Stage, Denver, Colo.

1,336,984. ANTIFREEZE DEVICE FOR FLUID-PRESSURE SYSTEMS. Alfred B. Wood, Chicago, Ill.

3. The combination with a fluid pressure system including a compressor for compressing fluid, of a receptacle containing alcohol and a wick exposed to the current of fluid passing to the suction inlet of the compressor and extending into said receptacle and adapted to be saturated with alcohol by capillary attraction.

1,336,994. VACUUM CLEANING APPARATUS. Charles W. Barnes, Logansport, Ind.

1,337,000. AIR-BLAST PRESSURE ATTACHMENT FOR PRESSES. William Cottrell, Riverside, Ill.

1,337,020. AIR-FILTER. Herbert P. Milker, Brooklyn, N. Y.

1,337,096. ELASTIC-FLUID TURBINE. Chester S. Rice, Schenectady, N. Y.

1,337,108. LIQUID-HYDROCARBON-VAPOR PRODUCER. John J. Weithaus, North Vernon, Ind.

1. In combination with a vessel containing air under continuous pressure, a liquid hydrocarbon containing tank, a main air pipe leading from said source into said tank, a liquid hydrocarbon conduit pipe opening from the lower end of said tank, the open end of said air pipe projecting down into said liquid hydrocarbon conduit, air conveying pipes leading into the tank from the main air line and terminating above the liquid, cutoff valves in said pipes, an external vaporizer including a coil through which hydrocarbon is lead and a heater for said coil, a cooling and conveying pipe leading from the vaporizer back to the tank above the level of the liquid and means for drawing off the vapor from the upper end of the tank.

APRIL 20

1,337,225. ARTIFICIAL RESPIRATOR. Clarence L. Heald, Cedar Rapids, Iowa.

1,337,250. APPARATUS FOR RAISING SUNKEN VESSELS. Hairabed M. Meguerditchian, Green Island, N. Y.

1,337,501. COMPRESSOR. Veronica Arluskes, Bridgeport, Conn.

1,337,532. PNEUMATIC SHOE-PRESS. Charles J. Stuart, New Haven, Conn.

1,337,564 AIR-STRAINER. Frederick Strattner Orem, Baltimore, Md.

1,337,622. VACUUM-SUCTION PLATE. Chas. N. Reese, Wilmette, Ill.

1,337,751. PRESSURE-GENERATING SYSTEM. John O. Carrey, St. Louis, Mo.

1,337,766. AIR-MOISTENER. Robert W. Hardie, White Plains, N. Y.

USE OF FREEZING PROCESS IN SHAFT SINKING

AT THE Chapin mine, Michigan, a shaft about 100 ft. deep was sunk through quicksand that was retained by means of a high circular cofferdam 50 ft. in diameter constructed by the freezing process. In the circumference of a 29-ft. circle 26 vertical ten-in. pipes 3½ ft. apart were driven about 100 ft. to bed rock and served as casings for permanent watertight eight-in. pipes, closed top and bottom. After the latter were placed the ten-in pipes were withdrawn, allowing the quicksand to close in on the eight-in. pipes. Brine at a temperature of minus 40° was circulated through 1½-in. vertical pipes with open lower ends extending to the bottom of the eight-in. pipes.

The brine pumped back to the refrigerating machine from the tops of the eight-in. pipes absorbed heat from the quicksand causing it to freeze and form a solid wall connecting the pipes and permitting the excavation to be commenced within fifteen days after refrigerating was started. The ground was thus frozen eventually to the center of the shaft and through a radius of more than 25 ft. enabling the excavation to be safely completed in 135 days. The cost of installation of the refrigerating plant and circulation pipes was of course heavy, but all risk was eliminated and difficult temporary sheeting was made unnecessary.

FOUNDRY HAS VARIED USES FOR AIR SPRAYER

A combination air and liquid gun has been designed for foundry use by the Malleable Iron Fittings Co., Branford, Conn., and is known as the Branford cleaner and sprayer. It can be used as a simple air jet omitting to attach the hose which conveys the spraying material. If it is desired to spray a mold or core with blacking, silica wash, graphite or any other material in liquid form, it is only necessary to attach the intake hose and proceed.

It can be used with excellent results in cleaning metal patterns as they come from the foundry and before they are placed in pattern storage, they can be sprayed with a paraffin coating to preserve them which can again be removed by spraying with kerosene before placing in use in the foundry. This adds to the life of metal patterns especially those mounted on plates.

This cleaner and sprayer can be used for white washing, for applying priming coats of paint filler on castings, finish painting, or in fact spraying any liquid material. It is not necesary to use thick material to get a thick coating. A very thin liquid will build up a heavy coat if the sprayer is held at one point long enough. This is especially true in coating molds with silica wash or coating with any high refractory material.

The irrigation reservoir which is being formed at Lake Arthur Hill, near the village of Bhandardara, Akola Taluka, in the extreme west of the Ahmednager District of the Bombay Presidency, will, when completed, contain some 85,000 million gallons of water, and cover an area of six square miles. The dam will be 270 ft. high, and will cost about $190 per million cubic feet of water stored.

A communication by M. Georges Claude has been made to the Paris Academy of Sciences to the effect that contrary to the generally received theory, it was not only possible but strikingly easy to produce and turn to industrial uses pressures of 1000 atmospheres and more. M. Claude has now succeeded in applying these very high pressures to the synthetic production of ammonia. Hitherto this had been done and applied only in Germany. M. Claude, however, has far outdistanced the German chemists. Whereas the German chemist Haber only obtains one-third of a gramme of ammonia per catalytic gramme, M. Claude obtains 10 grammes.

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